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THE MAKING OF MAN.

BY CHARLES MORRIS.

FOR a period of many millions of years—how many not even conjecture can decide—the world of vertebrate life continued quadrupedal, the seeming deviations therefrom being rather apparent than real. Suddenly a true biped appeared. For a period of equal duration the mentality of animals developed with excessive slowness. Suddenly a highly intellectual animal appeared. The coming of man indicated, both physically and mentally, an extraordinary deviation from the established course of organic development. Both physically and mentally, evolution seems to have taken an enormous leap, instead of proceeding by its usual minute steps; and in the advent of the human species we have a remarkable problem, whose solution is as difficult as it is important.

It might be solved in a moment were we able to accept the arguments of those who hold that man is the outcome of a distinct act of creation, and is invested with powers and qualities, and prepared for a destiny, in which from the beginning he has stood apart from all other living beings. Yet these arguments no biologist of our day can accept. It has become clearly apparent that the points of distinction between man and the lower animals are simply of degree, not at all of kind, and that both physically and mentally man comes into close contact with the lower forms of life. They do not only touch, they are intimately interwoven. There is an intricate net-work of structural relations which binds man inextricably to the realm of lower life. This realm is not alone the basis on which he rests. It is the soil from which he

has sprung, and into which he is so deeply rooted that not the hand of a god could tear him loose.

It is not our purpose here to give any of the arguments in favor of this conclusion. They may be found fully presented elsewhere. We design rather to endeavor to trace the line of ascent of man from the lower animal world, and to seek to discover to what combination of highly favorable circumstances his development is due.

Physically man does not deviate very greatly from the mammals next below him. His method of locomotion is essentially changed, but structurally he is very closely related to the higher apes. Yet so much are all living beings the creatures of circumstance, that it seems possible, and even probable, that the remarkable mental differentiation of man may be a necessary result of this comparatively slight physical differentiation. His erect attitude, with certain variations in his life-habits which directly arise from it, bring him into new relations with surrounding nature, and these new relations have certainly very much to do with the new conditions which have arisen within him. A single step may lead at times to a vast train of unexpected consequences, and such seems to have been the case with this new step in evolution made by man.

Man is the only true biped. He has but two points of support, while all other animals are supported at four or more specialized points, or else rest on the general surface of the body. In birds, for instance, which are usually considered bipeds, the wings are organs for aërial support, and have no other function. The nearest approach to man in this respect, among existing animals, may be found in the forms which progress by jumping, such as the kangaroo. Yet in these the structure and function of the fore limbs is distinctly locomotive. And such was probably the case with the dinosaurian reptiles of a past geological era, despite the fact that they seem to have been able to walk, to some extent, on their hind limbs alone.

It is certainly remarkable that, in the whole extended period of animal life, no single vertebrate form appeared, so far as we can discover, before the advent of man, in which the fore limbs were completely freed from duty as organs of support and became structurally unfit for this duty. A partial freedom in this respect would be of minor value, since the formation necessary to loco-

motive duty must be retained, and the development of any new functional power would be checked. Thus in this respect man is an anomaly in the kingdom of life. And to this anomalous feature is quite probably due in very considerable measure the peculiar character of his development.

It is very evident, indeed, that the full adoption of the erect attitude gave man an immense motor supremacy over the lower animals; for it completely released his fore limbs from duty as organs of support—for the first time in the known history of vertebrate life. They were set free to be employed in new methods and to develop new functional powers, to which the grasping function, which man inherits from the ape tribe, was an invaluable aid. It is to the possession of two limbs which are freed from any organic duty other than attack and defense, and which are adapted to grasp weapons and tools, that man owes his enormous advantage over the lower animals. It opens to him possibilities which do not exist beneath him. All the forces of nature are at his command, as soon as he can learn to control them. The first club or spear he grasped, the first missile he threw, inaugurated a new era in the history of life, and opened the way to man's complete mastery. And, so far as we can perceive, this important structural advantage preceded the development of his mental superiority, and gave the cue to it.

In the vertebrate class below man, there exists but a single animal form that possesses a limb which is free from duty as an organ of support. This is the elephant, whose nose and upper lip have developed into an enormous and highly flexible trunk, with delicate grasping powers. The possession of such an organ has undoubtedly had its share in the marked intellectual development of the elephant. Yet this organ is far inferior in its powers to the hand and arm of man, while the form, the size and the habits of this animal stand in the way of its gaining the full results which might arise from the possession of such an organ in connection with a better adapted bodily structure.

As to the evolutionary processes through which man gained the peculiar features of his structure, we have interesting evidence in the existing forms of life. In one type of life, and one alone, can we perceive indications of a gradual variation from the quadrupedal towards the bipedal structure. This is the ape type, or rather that of the lemurs and apes in conjunction. In all other mammalian types

the aspect of the body is distinctively horizontal. Life in trees does not necessarily produce a deviation from this horizontal aspect, since it is retained by all arboreal mammals except those just mentioned. Yet it offers an opportunity for such a deviation, and this opportunity has been improved by the lemurs and apes. Their hands have developed a grasping power which is possessed by no other arboreal animal, and which opens to them new motor possibilities. They may assume a semi-erect or a fully erect attitude, by grasping upper branches with the hands. And this ability, in the higher apes, has led to the development of a mode of progression on the ground which is more or less intermediate between the quadrupedal and the bipedal modes.

This fact is of great interest, as it seems to lead us directly towards the development of the bipedal habit, as attained in man. Though such a habit may be partly attained by tree-living animals, a residence on the ground is essential to its full development. And it is significant, in this connection, that no existing apes have fully given up the arboreal habit.

Of the anthropoid apes, the orang and the chimpanzee dwell habitually in the trees. On the ground they are out of their true element. The same is the case with all the species of the gibbons. All these creatures move with some difficulty on the ground, but freely and easily in the trees. The gorilla, on the contrary, seems to dwell more habitually on the surface. Its great weight tends to render an arboreal life unsuitable, and its hand is not so well adapted to climbing as that of the chimpanzee. Yet it has only in part given up its arboreal residence. It ascends trees for food and, to some extent, to sleep, though there is some reason to believe that the adult males sleep occasionally, and perhaps habitually, on the ground. It seems to be in a transition state between the arboreal and the surface life-habit.

Of the lower apes, the baboons make the ground their usual place of residence. They have not lost their climbing power, however, but can ascend trees with ease and rapidity. Most of the other apes dwell wholly, or nearly so, in the trees.

This fact of the partial or complete arboreal habit of all existing apes is of importance in this connection. It prevents any of them from attaining the peculiar structural development of man. The mode of progression best adapted to a life in trees is opposed to the erect attitude of man, and this attitude could not be fully

gained except by a species which dwelt wholly on the ground. And life in trees absolutely requires the use of the arms as locomotive organs, and prohibits that freeing of them from this duty which exists in man. When man ascends trees he is obliged to return to the habit of his ancestors and use his arms as organs of progression. It seems evident, therefore, that if man descended from the apes his ancestral species must have been a form which had fully given up its life in trees, and had become almost as awkward in climbing as man now is, ere it fairly began to change from ape into man.

The adoption of a surface residence by any ape would necessitate certain changes in structure. Tree-dwelling apes, when they descend to the ground, present us frequently with an awkward compromise between the horizontal and the vertical modes of motion. Neither of these modes is natural to them, and to become properly adapted to either some change of structure is necessary. Many of them progress in the true quadrupedal manner, and in one ground-living tribe, the baboons, the structure of the body has suffered an accordant change. They have become true quadrupeds.

In other cases there is an inclination towards an erect mode of motion. Even among the lemurs this is occasionally displayed. Some species of these progress on the ground by jumps, the body being semi-erect and the arms held above the head. The anthropoid apes all have a curious mode of progression on the ground, intermediate between the erect and the horizontal methods. The orang, the chimpanzee and the gorilla alike use their four limbs in progression, but in a manner very unlike that of ordinary quadrupeds. They swing the body in a curious fashion between the arms. It is a sort of half-jumping, half-walking motion. Resting the body on the hands, the animal swings itself between the arms, and moves forward by a quick succession of such lifts and swings. In this movement the orang and the chimpanzee bring their closed knuckles to the ground, but the gorilla is said to keep the hand open and apply the palm to the ground. The outer edge rather than the sole of the foot touches the ground. The whole movement is as awkward as is that of man when he attempts to climb trees, and seems to indicate that there can be no satisfactory compromise between the two life-habits. A surface-dwelling animal must tend to become either a quadruped or a biped.

The actual result in all these cases seems to depend largely on the comparative length of the arms and legs. All the three species named have shorter legs and longer arms than man, and can thus readily lift their bodies upon their arms while in a semi-erect attitude. Yet they all are obliged to incline the body forward in movement. This is less the case with the gibbons, the extreme length of whose arms enables them to reach the ground with the hands without bending the body. Thus the gibbons can walk on the four limbs with the body erect.

Certain species of the gibbon can readily walk erect on their legs alone by balancing themselves with their arms. They often do so, and can even move tolerably fast, the body rocking from side to side. But if urged to speed they drop their long arms to the ground and progress in the swinging fashion. Of the other forms there is no satisfactory evidence that the orang ever walks erect, though it may be able to assume the erect attitude when attacked. Mr. Savage says that the chimpanzees are sometimes seen walking erect, the body bent forward, with the hands clasped over the occiput to balance. But on the appearance of danger they immediately take to all fours to fly.

The gorilla seems more inclined to walk erect, or rather in an inclined position, the body bending forward, with the head hung down. And it stoops less, when on all fours, than the chimpanzee, since its arms are longer. When walking it balances its huge body by flexing its arms upwards. Its gait is a rolling one, from side to side. When attacked it seems to always assume the erect posture. In structural formation it is better fitted to the erect attitude than is the gibbon.

The subject here considered is of considerable importance in its relation to the evolution of man. We observe various phases of tendency towards the biped habit, and can readily perceive that the walking gibbons or the gorilla might in time become true bipeds if they should completely give up their arboreal residence. The length of the arms is an important element in this problem. In all the species mentioned the length of the arms differs, but in all it is longer, as compared with the body and legs, than in man. The species from which man descended, with its longer legs and shorter arms than in the existing anthropoid apes, could not, without the greatest difficulty, have adopted their swinging mode of motion. Nor could it advantageously have

assumed the quadrupedal habit, as in the baboon, whose four limbs are nearly equal in length. It was forced towards the bipedal habit by sheer necessity. On taking the ground surface for its place of residence, it was probably obliged to walk erect as the only movement to which its structure was well adapted. Neither the quadrupedal nor the semi-quadrupedal movement would have been suited to the proportions of its limbs, and its ancestral movement in trees may have been more vertical than is common with apes. Its bipedal development may have begun while it was still arboreal.

This erect posture once fully assumed and the arms thus completely freed from duty as organs of support, the animal, yet an ape, would have had an advantage of the greatest value over its fellow apes, and over all other members of the animal kingdom. Nearly all quadrupeds use their limbs to some extent in attack and defense. Yet the necessity of resting on these limbs interferes to a certain extent with this duty. In the animal in question the duty of locomotion being confined to the hind limbs, the fore ones were completely set free to be used as weapons. And to this power was added that very important one of their peculiar adaptation to grasping, which enabled the creature to add greatly to its natural strength by the use of missile and other weapons.

This advantage has not been confined to man and his progenitors. The power of the grasping function in this direction is of service to many of the apes. The story of the cocoanut-flinging monkeys does not need to be repeated. And it is equally well known that the orang, when attacked, will break off fragments of branches and shower them to the ground in a rage. But in all such cases there is nothing to indicate any precision of aim. The throwing seems to be done at random. It is probable that the arm has to be educated to the proper use of missiles, and that to gain this function it must be freed from other duties.

There is no positive evidence that any apes use weapons except in this manner. The story is told that the chimpanzee will wrest the spear from the hunter and use it against him. But this story needs to be verified. Also the common picture of the orang walking erect and supporting itself with a staff is entirely imaginative. Nothing of the kind was ever seen in nature. The teeth seem the main dependence of these creatures for purposes of

defense. They will break off limbs and twigs and make themselves beds with great rapidity, but this seems the utmost limit of their constructive powers.

As for the animal from which man descended, it must have quickly gone further than this in the use of artificial weapons and in the arts of construction. Possibly its first assumption of the erect attitude may have been aided by the use of a staff, and if so, this would naturally be employed as a club or a spear on occasion. Through uses of this kind the arms would gradually become educated to their new duties, and gain facility in important movements which were impossible while they were forced to retain their locomotive adaptation.

This line of argument need not be carried further. It is evident that we have here the beginning of a new course of development whose end is yet in the future. The freedom of the arms and hands from the duty of support, their grasping power, and the use of artificial weapons and tools, were unquestionably main elements in the evolution of man. For under such circumstances the employment of artificial instruments would naturally be progressive. There would be no limitation to this progress from the necessity of using the arms for other duties, and such structural limitation as may have originally existed must gradually have disappeared, through increasing performance of and growing adaptation of the arms and hands to these new duties. The use of clubs in attack and defense, and of stone missiles for the same purposes, might readily have been adopted by an ape so constituted, and modern archæologists do not hesitate to trace all subsequent development in the arts to just such a simple beginning. Rudely chipped stones are found as early weapons of primitive man. Naturally shaped stone weapons undoubtedly preceded them.

Whether one or more species attained this bipedal development is a question not easily settled. It is almost certain that there was one only. Yet, if so, variations in the structure of this original biped must have taken place at an early date, possibly ere it became a full biped and began to strongly resist the molding influences of nature, if we may judge from the essential structural differences between the principal races of mankind.

Yet highly favorable as was the structural development of the original man, it needs no extended consideration of the subject

to perceive that in this we have but one of the factors to which he owes his supremacy. The freeing of the arms to the performance of new duties was an essential agent in any rapid mental development. Yet it was not the only agent. The mental development of man began in the mental development of the apes. It is but the completion of a process which extends much further back than the beginning of the human era, and through which, in one type of life, the mammalian intellect attained an exceptional unfoldment. Human mental progress began at the high level attained by the anthropoid apes. To the causes of the unfoldment of the ape intellect some attention is therefore due.

There is nothing in an arboreal residence in itself to specially promote mentality. The squirrels and other arboreal quadrupeds are not of a high intellectual grade. Undoubtedly the activity, the variety of motions, and the grasping power of the monkeys must have aided in their mental unfoldment, yet we find that the lemurs, with the same general organization and life-habits, are intellectually dull. For the inciting element to the development of the ape intellect, therefore, we must look further.

Among the lower life forms the Carnivora are more intellectual as individuals than the Herbivora. Yet as groups the latter occasionally display intellectual conditions far higher than anything attained by the solitary Carnivora. These instances of intelligence are only found among the social species, and are displayed most remarkably in the communal classes, the ants, bees and beavers.[1] Yet even in these the purely plant-feeding bees fail to display the great variety of intelligent acts of the partly carnivorous and actively belligerent ants. It would appear, therefore, that while the activity and cunning arising from carnivorous habits aid in the development of individual intelligence, it is equally aided by social habits, and that a combination of these two requisites presents the most favorable condition for high progress in intelligence.

In fact, if we consider fully the ants, we find that these minute creatures, with none of the advantages in structure over their fellows possessed by man, have advanced politically and industrially to a level which was not reached by man until after he had dwelt for ages upon the earth. And, so far as all indications point, this exceptional development is due to social or communal

[1] See Communal Societies, *Popular Science Monthly*, Jan., 1886.

influences alone. It appears, therefore, that social combination is a highly essential agent in intellectual development, quite as important as, perhaps more important than, any special advantages in structure and individual habits.

The solitary life of cats, spiders, &c., while aiding to develop mentality in individuals, prevents the transmission of useful ideas. Only instincts are transmitted. Ideas die with their originators. On the other hand, the communal habits of ants and bees, while highly adapted to the preservation of useful ideas, tend to hinder individual excursions of mind and the rapid growth of ideas. An ant community is a society of strict specialists. The best condition for intellectual progress would seem to be an intermediate one, in which complete individual activity exists, yet in which social links are closely drawn, so that ideas may be transmitted by education and observation, as well as instincts by heredity. And to the fullest utility of this condition some degree of carnivorous habits would seem essential. It needs no intellectuality to gather fruit from the trees. It needs often the highest exercise of cunning to capture animal prey, while it produces a variety of perilous and exciting situations to which the strict vegetarian is not subjected.

Among modern apes socialism exists in various degrees. The lemurs display but little socialism. Some species of monkeys display it in a high degree, and it is a general characteristic of the family. Mutual aid in danger is common, education is not wanting, combination in enterprises is frequently observed, and probably through these and the like influences, observation and imitation have been developed to a degree not seen elsewhere among the Mammalia. Yet so advantageous is social combination in promoting intelligence, that the high degree of cunning displayed by baboons, in posting sentries while robbing fruit plantations, is but a fuller development of a similar habit possessed by several species of otherwise dull social animals.

Among the existing anthropoid apes, however, the social habit is greatly lacking. The orang, the chimpanzee and the gorilla are more or less solitary in their habits. The orang is particularly so, and is never seen in groups of more than two or three. The chimpanzee and the gorilla are somewhat more social, yet not markedly so. The groups of the gorillas appear to be polygamous bands, since they never possess more than one adult male,

the rest of the band being composed of females and young. There is more evidence in favor of the chimpanzees combining in larger groups, yet this does not appear to be their usual habit. Reade remarks that both these species, without being gregarious, sometimes seem to assemble in large numbers. Unfortunately very little satisfactory information is possessed as to their habits in a state of nature.

These large apes are also strictly vegetarian. They lack the incitement to intellectual development arising from carnivorous habits. On the whole, then, their marked powers of intellect are somewhat surprising. It is probable, if we may judge from the habits of the lower monkeys, that the anthropoids descended from social species, and have in part lost their social habits. This is also indicated by the fact that the young of these anthropoid apes seem more inclined to socialism than do the adults. It is also shown in the higher socialism of the gibbons, the existing representatives of the primitive anthropoids.

If we seek, then, for the ancestors of man in the family of apes, we must look for a species possessed of several essential requisites, all of which can be found in no existing apes. These requisites, as considered in the preceding pages, may be briefly summarized.

The ancestor of man must have been of sufficient size and weight both to render continued life in the trees inconvenient and to give the necessary strength to combat with the perils of a surface life. His strength, indeed, must have been sufficient, combined with his cunning, to make him a match for the larger animals. He must have been aggressive as well as defensive, and if not originally carnivorous must have become so in a degree. Strictly herbivorous habits would have tended to check mental development.

Second, and yet more important, was the assumption of an erect attitude, and of a true biped structure, with the complete freeing of the fore limbs from duty in locomotion. There naturally followed upon this an increase of that use of missiles already possessed by the apes, with an advancing skill in the use of artificial weapons as the arms became adapted to this new function. With this came that dominance over the lower animal world which has been so essential a feature in the progress of man. And with it began his still increasing control of the energies of nature.

To these physical conditions must be added the social one. The ancestors of man could not have been solitary in their habits, but must have been strongly social. It is possible that the solitary condition of the existing great apes is a result of their strictly vegetarian habits. An anthropoid with carnivorous tendencies and original social habits would tend to increase rather than to lose these habits, through the great benefit derived from mutual aid in conflicts with the larger animals. That man, at an early period in the stone age, waged war with the largest animals, we have satisfactory evidence in the results of archæological discovery.

The original human society must have been one of mutual aid, combination in enterprises, some degree of language, or of the use of sounds conveying warning and information, protection and education of the young, and habits of observation and imitation. All these exist in some tribes of monkeys. As to vocal powers, the gibbons possess them in a high degree, though there is no evidence to show that any existing apes have specialized sounds to convey special information. It is to a group of the higher apes which possessed these characteristics in an unusual degree that we must look for the ancestors of man. If we be asked for traces of such a group we can but point to man. The ancestral line has vanished in that of its descendants. The existing anthropoid apes are but side issues in the problem.

The development of the social condition and of the educational process must have had a vigorous influence in the enlargement of the brain. In man the dividing line between the physical and the mental powers, as organizing agents, was finally passed. A tribe had arisen, for the first time in the long history of animal life, that trusted more to its mind than to its muscles, and which had begun to substitute artificial for natural tools and weapons. With the attainment of this condition there was taken the first decided step in that long line of mental progress which has produced the brain of man. In all preceding ages evolution had been mainly physical, and exerted its chief influence upon the limbs and muscles. Now, for the first time, mental evolution gained the supremacy, and development centered itself in the brain, the organ of the mind, while the body, in great measure, ceased to change.

Under these circumstances there is nothing very surprising in the fact that the human brain has attained an exceptional devel-

opment, or that its growth was strongly marked at a very early date. How far it has increased in size over that of its non-human ancestor, we cannot judge from comparison with the brains of any existing apes, since these may be of a much lower grade of development. They are probably not fair standards of comparison. And if the body stood almost unchanged for ages, and all the influences of nature centered themselves upon the brain, a considerable increase in size and some variation in structure were inevitable consequences, and it is not easy to perceive, under the circumstances, that there is anything extraordinary in the special growth of the human brain.

In the making of man, then, we perceive the critical step that took the animal world over the dividing line between physical and mental evolution; and in human development we are concerned, not with the maturity of an old, but with the infancy of a new evolutionary process, which is full of far-reaching and extraordinary possibilities, of which the intellectual progress yet attained by man may be but the beginning. There may be needed as many millions of years for the full development of the mind as have been consumed in the evolution of the body, and the organ of the mind may yet attain an importance in the scheme of the physical organism of which we have no conception.

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REVIEW OF THE PROGRESS OF NORTH AMERICAN INVERTEBRATE PALÆONTOLOGY FOR 1885.

BY J. B. MARCOU.

THE year which has just passed shows a marked increase in the number of palæontologic articles. The tendency to publish new species without any illustrations is also diminishing, and those interested in the science can look with great satisfaction on the augmented activity of North American invertebrate palæontology.

T. H. Aldrich gives "Notes on the Tertiary of Alabama and Mississippi, with descriptions of new species," and "Notes on Tertiary fossils, rare, or little known," in the Jour. Cincinnati Soc. Nat. Hist., Vol. VIII, pp. 145 and 153. "Observations upon the Tertiary of Alabama" appeared in the *Amer. Jour. Sci.*, 3d ser., Vol. XXX, p. 300.

H. M. Ami has a "List of fossils from Ottawa and vicinity,"

and "Additional notes on the geology and palæontology of Ottawa and vicinity," in the Ottawa Field Naturalists' Club Trans., Nos. 5 and 6, Vol. II, p. 251.

Francis Bain and (Sir) J. W. Dawson have a joint paper, "Notes on the geology and fossil flora of Prince Edward island," in the *Canadian Rec. Sci.*, Vol. I, p. 154.

C. E. Beecher publishes a "List of the species of fossils from an exposure of the Utica slate and associated rocks within the limits of the city of Albany," in the 36th Rep. New York State Mus. Nat. Hist., p. 78.

W. R. Billings describes "Two new species of Crinoids," and gives the "Report of the palæontological branch" in the Ottawa Field Naturalists' Club Trans., No. 6, Vol. II, pp. 248 and 259.

N. L. Britton has an article on the discovery of "Cretaceous plants from Staten Island" in the Trans. N. Y. Acad. Sci., Vol. v, p. 28.

N. L. Britton and Arthur Hollick have an article on "Leaf-bearing sandstones on Staten Island, New York," in the Trans. N. Y. Acad. Sci., Vol. III, p. 30.

Charles Brongniart has "Les Insectes Fossiles des Terrains Primaires, Coup d'œil rapide sur la faune entomologique des terrains paléozoiques," in the Bulletin de la Société des Amis des Sciences Naturelles de Rouen, 3e serie, Vingt et unième année, 1er semestre, p. 50. This article was translated in the *Geol. Mag.*, new series, Dec. 3, Vol. II, p. 481.

R. E. Call writes "On the Quaternary and recent Mollusca of the Great basin, with descriptions of new forms;" this constitutes Bulletin 11 of the U. S. Geol. Survey.

P. H. Carpenter prints "Further remarks upon the morphology of the Blastoidea" in the *Ann. and Mag. Nat. Hist.*, 5th ser., Vol. xv, p. 277. This is an answer to and a criticism of Mr. G. Hambach's article entitled, "Contributions to the anatomy of the Pentremites, with descriptions of new species," in the Trans. St. Louis Acad. Sci., Vol. IV, p. 145.

J. M. Clarke gives "A brief outline of the geological succession in Ontario county, N. Y., to accompany a map," in the Report State Geologist for 1884, p. 9. In this he gives lists of fossils occurring in the different Devonian formations. Bulletin U. S. Geol. Survey, No. 16, is "On the higher Devonian faunas of Ontario county, New York."

E. W. Claypole has an article "On the vertical range of certain fossil species in Pennsylvania and New York" in the AMERICAN NATURALIST, Vol. XIX, p. 644.

J. C. Cooper has an article "On fossil and sub-fossil land shells of the United States, with notes on living species," published by the California Academy of Sciences, pp. 235–255.

W. H. Dall notices the "Miocene deposits in Florida" in *Science*, Vol. VI, p. 82. He has also "Notes on some Floridan land and fresh-water shells, with a revision of the Auriculacea of the Eastern United States," in Proc. U. S. Nat. Mus., Vol. VIII, p. 255. In Bulletin of the U. S. Geol. Survey, No. 24, is a "List of marine Mollusca, comprising the Quaternary fossils and recent forms from American localities between Cape Hatteras and Cape Roque, including the Bermudas."

J. D. Dana has a note on "Lower Silurian fossils at Canaan, N. Y.," in *Science*, Vol. VI, p. 283.

N. H. Darton has a "Preliminary notice of fossils in the Hudson River slates of the southern part of Orange county, N. Y., and elsewhere," in the *Amer. Jour. Sci.*, 3d ser., Vol. XXX, p. 452.

G. M. Dawson, in the Bull. Chicago Acad. Sci., Vol. I, No. 6, p. 59, has an article entitled, "Boulder clays. On the microscopic structure of certain boulder clays and the organisms contained in them."

(Sir) J. W. Dawson has "On Rhizocarps in the Paleozoic period;" "Notes on *Eozoön canadense*;" "The Mesozoic floras of the Rocky Mountain region of Canada;" and "Ancient insects and scorpions," in the *Canadian Rec. Sci.*, Vol. I, pp. 19, 58, 141 and 207. He has also "A modern type of plant in the Cretaceous," and "A Jurasso-Cretaceous flora in the Rocky mountains," in *Science*, Vol. V, pp. 514 and 531. "The Cretaceous floras of Canada," in *Nature*, Vol. XXXIII, p. 32; and "Sir William Dawson on the Mesozoic floras of the Rocky Mountain region of Canada," in the AMERICAN NATURALIST, Vol. XIX, p. 609, are abstracts and notices published in advance from the author's essay "On the Mesozoic floras of the Rocky Mountain region of Canada," in the Trans. Roy. Soc. Canada, Vol. III, Sect. IV, p. 1.

S. W. Ford has a "Note on the age of the slaty and arenaceous rocks in the vicinity of Schenectady, Schenectady county, New York," in the *Amer. Jour. Sci.*, 3d ser., Vol. XXIX, p. 397.

W. F. E. Gurley describes some "New Carboniferous fossils"

in Bulletin No. 2 of his own series; no illustrations accompany these descriptions.

James Hall has published a large number of papers, some of which have appeared in limited editions in previous years, but they have not yet been noticed in these reviews. He publishes a "Note on the intimate relations of the Chemung group and Waverly sandstone in Northwestern Pennsylvania and Southwestern New York," and a "Note on the Eurypteridæ of the Devonian and Carboniferous formations of Pennsylvania, with a supplementary note on the *Stylonurus excelsior*," in the Proc. A. A. A. S., Vol. XXXIII, Part II, pp. 416 and 420. In the 2d Geol. Surv. Pennsylvania, Rep. of progress PPP, p. 23, he has a "Note on the Eurypteridæ of the Devonian and Carboniferous formations of Pennsylvania." In the Rep. State Geologist for 1881, p. 8, there is a "Classification of the Lamellibranchiata." In the Rep. State Geologist for 1882, p. 5, there is a "Discussion upon the manner of growth, variation of form and characters of the genus Fenestella, and its relations to Hemitrypa, Polypora, Retepora, Cryptopora, etc." This article is continued in the Rep. State Geologist for 1884, p. 35. Sixty-one photo-lithographed plates accompany the Rep. State Geologist for 1882. They are published in advance, with their explanations, under the following heads: "Fossil corals and Bryozoans of the Lower Helderberg group, and fossil Bryozoans of the Upper Helderberg group," p. 17, plates I–XXXIII, in advance of Vol. VI, Palæontology of New York; "Brachiopoda, plates and explanations," pls. XXXIV–LXI, in advance of Vol. IV, Part II, Palæontology of New York. In the Rep. State Geologist for 1883, p. 5, he gives a "Description of the Bryozoans of the Hamilton group (Fenestellidæ excepted)." The 35th Rep. New York State Mus. Nat. Hist. contains the following papers: "Notice of the machinery and methods of cutting specimens of rocks and fossils at the New York State Mus. Nat. Hist," p. 121; "Preliminary notice of the lamellibranchiate shells of the Upper Helderberg, Hamilton and Chemung groups, preparatory for the Palæontology of New York," Part I, p. 215; "Description of fossil corals from the Niagara and Upper Helderberg groups," p. 407; and "Illustrations of the microscopic structure of Brachiopoda," pl. XXII. The 36th Rep. New York State Mus. Nat. Hist., contains the following papers: "Bryozoa (Fenestellidæ) of the Hamilton group," p. 57; "On the structure of the

shell in the genus Orthis," p. 73; "Description of a new species of Stylonurus from the Catskill group," p. 76; and "Description of a new genus from Greenfield, Saratoga county, N. Y.," pl. VI. The Rep. State Geologist for 1884 contains the following papers: "On the mode of growth and relations of the Fenestellidæ," p. 35, continued from p. 14 of the Rep. State Geologist for 1882; "On the relations of the genera Stictopora, Ptilodictya, Acrogenia and allied forms in the Palæozoic rocks of New York," p. 46; and "Note (on some Paleozoic pectenoid shells)," p. 47.

Angelo Heilprin has published a book entitled, "Town Geology: the lesson of the Philadelphia rocks. Studies of nature along the highways and among the byways of a metropolitan town;" plates IV and V contain figures of the Cretaceous invertebrate fauna. In *Science*, Vol. V, p. 475, and Vol. VI, p. 83, he has two notes on "The classification and palæontology of the U. S. Tertiary deposits;" these are criticisms of Dr. Otto Meyer's views.

E. W. Hilgard has two papers, one in *Science*, Vol. VI, p. 44, entitled, "The classification and palæontology of the U. S. Tertiary deposits;" and the other in the *Amer. Jour. Sci.*, 3d ser., Vol. XXX, p. 266, entitled, "The old Tertiary of the Southwest;" both are criticisms of Dr. Otto Meyer's views.

G. J. Hinde has a "Description of a new species of Crinoids with articulating spines," in the *Annals and Magazine of Natural History*, 5th ser., Vol. XV, p. 157.

Alpheus Hyatt, in the Proc. A. A. A. S., Vol. XXXIII, Part II, pp. 490 and 492, publishes two notes, one on the "Structure of the siphon in the Endoceratidæ," and the other on the "Structure and affinities of Beatricea." He has a letter (relative to the Pteropods of the St. John group) in the Bull. Nat. Hist. Soc. New Brunswick, No. IV, p. 102. In the Proc. Boston Soc. Nat. Hist., Vol. XXIII, p. 45, he has published an elaborate discussion of the "Larval theory of the origin of cellular tissues."

J. F. James, in the Jour. Cincinnati Soc. Nat. Hist., Vol. VII, p. 151, has an article on the "Fucoids of the Cincinnati group." In the AMERICAN NATURALIST, Vol. XIX, p. 165, he has a note entitled, "Are there any fossil Algæ?" He has also, "Remarks on a supposed fossil fungus from the coal measures;" "Remarks on some markings of the rocks on the Cincinnati group, described under the names of Ormathicuus and Walcottia;" and "Remarks

on the genera Lepidolites, Anomaloides, Ischadites and Receptaculites, from the Cincinnati group," in the Jour. Cincinnati Soc. Nat. Hist., Vol. VIII, pp. 157, 160 and 163.

A. A. Julien has "A study of *Eozoön canadense;* filed observations," in the Proc. A. A. A. S., Vol. XXXIII, Part II, p. 415.

G. F. Kunz has an article "On the agatized woods, and the Malachite, Azurite, etc., from Arizona," in the Trans. N. Y. Acad. Sci., Vol. V, p. 9.

Leo Lesquereux's "Contributions to the fossil flora of the Western Territories. Part III. The Cretaceous and Tertiary floras. Rep. U. S. Geol. Surv. Terr., F. V. Hayden, U. S. geologist in charge. 4to, Vol. VIII." Was not published till February, 1885, although it bears the imprint 1883.

A. H. Mackay publishes an article on the "Organic siliceous remains in the lake deposits of Nova Scotia," in the *Canadian Rec. Sci.*, Vol. I, p. 236.

Jules Marcou writes on "The Taconic system and its position in stratigraphic geology," in the Proc. Amer. Acad. of Arts and Sciences, new series, Vol. XII, p. 174.

J. B. Marcou records "Progress of North American invertebrate palæontology for 1884," in the AMERICAN NATURALIST, Vol. XIX, p. 353. This is a brief sketch of the palæontologic work done in the year; a more extended review of it is published in the Smithsonian report for 1884, No. 610, pp. 1–20, Washington, 1885. In the Proc. U. S. National Museum, Vol. VIII, p. 290, he has "A list of the Mesozoic and Cenozoic types in the collections of the U. S. Nat. Museum;" and the "Identification of certain fossils and strata of the Great Sioux Reservation" (in "The Lignites of the Great Sioux Reservation, a report on the region between the Grand and Moreau rivers, Dakota," by Bailey Willis, Bull. U. S. Geol. Sur., No. 21, p. 11).

G. F. Matthew has "Recent discoveries in the St. John group," and "A new genus of Cambrian Pteropods," in the *Canadian Rec. Sci.*, Vol. I, pp. 136 and 152. In the Bull. Nat. Hist. Soc. New Brunswick, No. IV, p. 97, he has "An outline of recent discoveries in the St. John group. With a letter of Professor Alpheus Hyatt relative to the Pteropods." In the *Amer. Jour. Sci.*, 3d ser., Vol. XXX, p. 72, he has a note "On the probable occurrence of the great Welsh Paradoxides, *P. davidis*, in America." In the same volume, p. 293, he has a "Notice of a new

genus of Pteropods from the St. John group (Cambrian)." In this he describes the genus Diplotheca. He has a "Note on the genus Stenotheca" in the *Geol. Mag.*, new series, Decade III, Vol. II, p. 425. In the Trans. Roy. Soc. Canada, Vol. II, Sec. IV, p. 99, appear his "Illustrations of the fauna of the St. John group continued; and a paper on the Conocoryphea, with further remarks on Paradoxides."

Charles Morris, in the Proc. Acad. Nat. Sci. Philada. for 1885, pp. 97 and 385, has two articles entitled, "The primary conditions of fossilization," and "Attack and defense as agents in animal evolution."

Otto Meyer, in the *Amer. Jour. Sci.*, 3d ser., Vol. XXIX, p. 457, and Vol. XXX, pp. 60 and 421, has an article in three parts, entitled "The genealogy and the age of the species in the southern old Tertiary." The author assumes the extraordinary position that the succession is just the contrary from what it has hitherto been considered to be, the Vicksburg, according to him, being the oldest and the Claiborne the most recent formation. In "Part I. The geological relations of the species," he partially describes a number of species and varieties, without any illustrations; these he considers to be new. Part II is on "The age of the Vicksburg and the Jackson beds." Part III, "Reply to criticisms." The author defends his views against the criticisms of E. W. Hilgard, E. A. Smith and T. H. Aldrich, in the October number of the *Amer. Jour. Sci.* In *Science*, Vol. V, p. 516, and Vol. VI, p. 143, he has two notes on Angelo Heilprin's criticism of his work.

J. S. Newberry, in the Ann. N. Y. Acad. Sci., Vol. III, p. 217, has a "Description of some peculiar screw-like fossils from the Chemung rocks." They are also described in the Trans. N. Y. Acad. Sci., Vol. III, p. 33.

H. A. Nicholson and Robert Etheridge, Jr., in the *Geol. Mag.*, new series, Decade III, Vol. II, p. 529, have an article "On the synonymy, structure and geological distribution of *Solenoptera compacta* Billings sp."

H. A. Nicholson and A. H. Foord, in the *Ann. and Mag. Nat. Hist.*, 5th ser., Vol. XVI, p. 496, have an article "On the genus Fistulipora McCoy, with descriptions of several species."

A. S. Packard, in the AMERICAN NATURALIST, Vol. XIX, pp. 291, 700, 790 and 880, has the following articles: "Types of Carboniferous Xiphosura new to North America;" "The Syncarida, a

group of Carboniferous Crustacea;" "On the Gampsonychidæ, an undescribed family of fossil schizopod Crustacea;" "On the Anthracaridæ, a family of macrurous decapod Carboniferous Crustacea, allied to the Eryonidæ."

B. N. Peach, in *Nature*, Vol. XXXI, p. 295, has "Ancient air-breathers;" a general review of Paleozoic scorpions.

J. H. Perry, in the *Amer. Jour. Sci.*, 3d ser., Vol. XXIX, p. 157, has a "Note on a fossil coal plant found at the graphite deposit in mica-schist at Worcester, Mass."

Julius Pohlman and R. P. Whitfield, in *Science*, Vol. VI, p. 183, have a note on "An American Silurian scorpion."

A reprint of geological reports and other papers on the geology of the Virginias, by the late William Barton Rogers, has been issued.

S. H. Scudder publishes "The geological history of Myriopods and Arachnids. Eighth annual address of the retiring president of the Cambridge Entomological Club," in *Psyche*, Vol. IV, January–March, 1885, p. 245. In the Mem. Nat. Acad. Sci., Vol. III, p. 1, he has a "Description of an articulate of doubtful relationship from the Tertiary beds of Florissant, Colorado." In the Proc. Acad. Nat. Sci. Philada. for 1885, pp. 34 and 105, he has "New genera and species of fossil cockroaches from the older American rocks;" and "Notes on Mesozoic cockroaches." In the AMERICAN NATURALIST, Vol. XIX, p. 876, is an abstract of his paper on the "Relations of the Paleozoic insects."

H. M. Seeley, in the *Amer. Jour. Sci.*, 3d ser., Vol. XXX, p. 355, describes "A new genus of chazy sponges, Strephochetus."

E. A. Smith, in the *Amer. Jour. Sci.*, 3d ser., Vol. XXX, p. 270, has "Remarks on a paper of Dr. Otto Meyer on 'Species in the southern old Tertiary.'"

C. Wachsmuth and W. H. Barris have "Descriptions of new Crinoids and Blastoids from the Hamilton group of Iowa and Michigan."

C. Wachsmuth and Frank Springer issue a "Revision of the Palæocrinoidea. Part III. Discussion of the classification and relations of the brachiate Crinoids, and conclusion of the generic descriptions," in the Proc. Acad. Nat. Sci. Philada. for 1885, p. 225.

C. D. Walcott has a "Description of the (Deer creek, Arizona) coalfield," Senate Ex. Doc. No. 20, 48th Congress, second ses-

sion, Appendix I, p. 5. He contributes the following papers to the *Amer. Jour. Sci.*, 3d ser., Vol. XIX, pp. 114 and 328, and in Vol. XXX, p. 17, "Palæontologic notes;" "Paleozoic notes, new genus of Cambrian Trilobites, Mesonacis;" and "Note on some Paleozoic Pteropods."

L. F. Ward, in the *Botanical Gazette*, Vol. IX, p. 169, has "The fossil flora of the globe." In the Proc. A. A. A. S., Vol. XXXIII, Part II, pp. 493, 495 and 496, he has "Historical view of the fossil flora of the globe;" "Geological view of the fossil flora of the globe;" and "Botanical view of the fossil flora of the globe." In the AMERICAN NATURALIST, Vol. XIX, pp. 637 and 745, he has an article on "Evolution in the vegetable kingdom."

C. A. White has "The application of biology to geological history, a presidential address delivered at the fifth anniversary meeting of the Biological Society of Washington, January 24, 1885," in the Proc. Biol. Soc. Washington, Vol. III, p. 1. In the *Amer. Jour. Sci.*, 3d ser., Vol. XXIX, pp. 228 and 277, he has "Notes on the Jurassic strata of North America;" and "The genus Pyrgulifera Meek, and its associates and congeners." Bull. U. S. Geol. Surv., No. 15, is "On the Mesozoic and Cenozoic palæontology of California." Bull. U. S. Geol. Surv., No. 18, is "On marine Eocene, fresh-water Eocene and other fossil Mollusca of Western North America;" it is divided into three parts: I. The occurrence of *Cardita planicosta* Lamarck, in Western Oregon; II. Fossil Mollusca from the John Day group in Eastern Oregon; III. Supplementary notes on the non-marine fossil Mollusca of North America. Some additions and corrections for the illustrations on p. 19 are made to the above work. Bull. U. S. Geol. Surv., No. 22, is "On new Cretaceous fossils from California."

J. F. Whiteaves has a "Report on the Invertebrata of the Laramie and Cretaceous rocks of the vicinity of the Bow and Belly rivers and adjacent localities in the Northwest Territory" in the Geol. and Nat. Hist. Surv. Canada, A. R. C. Selwyn, director; Contribution to Canadian palæontology, Vol. I, Part I. In the *Amer. Jour. Sci.*, 3d ser., Vol. XXIX, p. 444, he has "Notes on the possible age of some of the Mesozoic rocks of the Queen Charlotte islands and British Columbia." In the Trans. Roy. Soc. Canada, Vol. II, pp. 237 and 239, he has "Description of a new species of Ammonite from the Cretaceous rocks of Fort St. John,

on the Peace river," and "Note on a decapod Crustacean from the Upper Cretaceous of Highwood river, Alberta, N. W. T."

R. P. Whitfield contributes to *Science*, Vol. VI, p. 87, "An American Silurian scorpion." In the Bull. Amer. Mus. Nat. Hist., October 10, 1885, Vol. I, No. 6, pp. 181, 191 and 193, he has the following articles: "On a fossil scorpion from the Silurian rocks of America;" "Notice of a new Cephalopod from the Niagara rocks of Indiana;" "Notice of a very large species of Homalonotus from the Oriskany sandstone formation."

H. S. Williams, in the Proc. A. A. A. S., Vol. XXXIII, Part II, p. 422, publishes an article on "Geographical and physical conditions as modifying fossil faunas." In the *Amer. Jour. Sci.*, 3d ser., Vol. XXX, p. 45, he has a "Notice of a new limuloid Crustacean from the Devonian."

A. Winchell, in the *Amer. Jour. Sci.*, 3d ser., Vol. XXX, pp. 316 and 317, has "Notices of N. H. Winchell on Lingula and Paradoxides from the red quartzites of Minnesota," and "On Cœnostroma and Idiostroma and the comprehensive character of Stromatoporoids."

N. H. Winchell describes "Fossils from the red quartzites at Pipestone" in the Geol. and Nat. Hist. Surv. Minnesota, 13th Ann. Rep., p. 65.

H. H. Winwood, in the *Geol. Mag.*, new series, Decade III, Vol. II, p. 240, remarks on the "Geological age of the Rocky mountains;" in it he reports finding a Menevian fauna between the 116th and 117th parallels of longitude on the Canadian Pacific railway.

B. H. Wright, in the 35th Rep. N. Y. State Mus. Nat. Hist., p. 195, contributes "Notes on the geology of Yates county, N. Y."

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GRAVITATION AND THE SOARING BIRDS.

BY I. LANCASTER.

"IN experimental philosophy, all propositions collected by induction from phenomena are to be held either exactly or approximately true until other phenomena are found by which those propositions can be made either more accurate or subject to exceptions" (Newton's Principia, Book III).

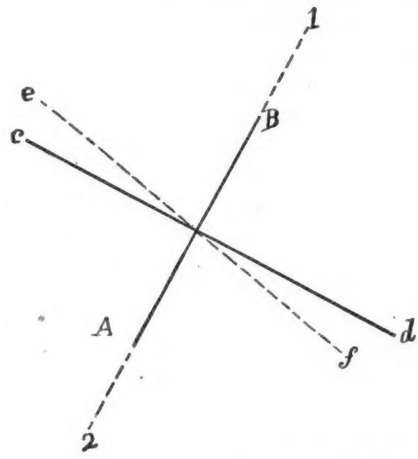
The soaring birds seem to be excused from obedience to the laws determining the actions of other inert bodies heavier than

the air, which are abandoned to its support. Weighing more than the air they displace, and using no muscular exertion to sustain themselves, they still, in the sense of getting nearer to the earth, do not fall. When we seek for a motive power which is competent to resist the weight of the bird's body, and neutralize the resistance of the air to its translation, we seem baffled. Bird and air form a material system in which no other object is included, so that it is impossible to obtain power from the wind. Wind is motion of the entire system as a whole, compared to a fixed object, as an observer, and such motion does not affect the motion of the parts. Wind from any direction, or at any velocity, or entire calm are differences of air-conditions to an observer, but not to a bird. We are therefore limited to the gravitating force of the bird's body to find the power producing the phenomena, as it is nowhere else discoverable. But here we are confined to certain notions derived from sticks and stones, and in fact all other falling things, and they do not seem to help us in explaining a thing which does not fall. We are likewise taught that the direction of the gravitating force is vertically downwards, *i. e.*, in a straight line from the body manifesting it to the center of the earth. What we understand by this "direction" is, that when gravity does work, when it is in the act of making anything different from what it was before, when it moves a thing at rest, or stops it when in motion, or accelerates it, or is in the act of manifesting energy in the way which we call "work," that the "direction" in which it does it is vertically downwards. How then can this force drive a body upwards, or translate it horizontally?

Still further. Although we admit, when our attention is called to it, that weight is the result of gravity acting on a quantity of matter, we are apt to confound mass, and weight, and gravity into one identical thing. This is inadmissible, since the doctrine of the correlation of forces is established, as it is entirely possible to change every atom of gravitating force which a body manifests into some other form of force, in which case either the former is separate from the quantity of matter or the latter is created. We thus find ourselves in a sort of dilemma. We are obliged to consider gravity as something apart from body, and still we have no knowledge of it excepting what we are enabled to infer about it. Were it not for these inferences we would be shut up to the conclusion that the quantity of matter was acting, and that grav-

ity, as a separate force, was simply non-existent, for it never manifests its power but in connection with body, and the action of the body is our rule to determine the action of the force.

It would be expected that in dealing with agencies of this kind, the greatest care should be exercised lest we fall into errors, and it is apparent that many of our notions in regard to gravitating bodies have been brought up from generalizations which do not include all the facts. The soaring birds have been omitted. To the extent of their exclusion our ideas are subject to error. It is imperative that they be brought under the dominion of gravity, and that the phenomena presented by them shall have due recognition in determining the characteristics of that force.



I have shown in the pages of this magazine that these birds can be reduced to lower terms. A plane resting in air, and acted on by a force, exhibits all their activities, and up to this time, so far as my knowledge extends, the mechanical world has failed to recognize the facts exhibited by such a body, when subjected to work on elastic air.

To accomplish my purpose most directly, it will be best to touch upon ground already covered, and I will do so in the following propositions, which are self-evident on statement. Unless otherwise noted, acceleration will be supposed to have terminated and uniform motion progressing.

As there is no authority for the value of frictional resistance of air on smooth surfaces, and as I have failed to measure it by any experimental test at my command, on account of its extreme smallness, the argument would be in no wise affected if it were not taken into account for any of the velocities that we shall deal with. The reader may therefore place upon it any value within reasonable limits.

Let $A\ B$ represent one of the edges of a plane, say one foot square, resting in air, and of the same weight as the atmosphere it displaces.

1. The only actual or conceivable work the plane can be subject to under the dominion of any force whatever, is either air pressure upon its sides, or resistance to atmospheric surface or skin friction, parallel to itself or in its own plane.

2. From the law of fluid pressures, and the contrary and equal character of action and reaction, a force operative upon the plane $A\ B$ from any direction, does work in one, or both, of two ways, viz., either in it or at right angles to it.

3. Forces in the direction of $c\ d$, or in the plane in any direction, are not resolved by the plane, but work to their full value in absolute independence of each other, as they are right-angled forces.

4. Forces from any direction, excepting in the plane and normal to it, are resolved by the plane into those two directions.

5. Any number of forces, not in the plane nor normal to it, operate upon it in the resultant of one force, from one direction; and this resultant, if not already in the plane or normal to it, is resolved therein by the plane.

6. It follows that the plane can be subject to work only, (1) in its own plane, (2) in a direction at right angles to its surfaces, (3) in both of these directions.

7. The nature of the work done by the force acting normal to the plane is compressing air, and as the resistance of the atmosphere to motion in this direction is very great, the velocity will be correspondingly slow.

8. The nature of the work done by the force in the plane, is overcoming atmospheric friction on the two surfaces, which being very little, motion in this direction will be correspondingly great.

9. A force not in the plane, nor normal to it, is resolved by the

plane into those forces in the same ratio that the direction of t force bears to those directions.

To illustrate these propositions we will suppose a force, *e* ; clined 18° from *c d*, to operate on the plane *A B*, with a valu sixty foot pounds per second. The plane would instantly resolve this force into twelve foot pounds in its own plane in the direction 2, and forty-eight foot pounds in the direction *c d*, at right angles to it, when it would be reasonable to suppose that the twelve pounds would drive the plane against friction of air with far greater velocity than forty-eight pounds would against air compression.

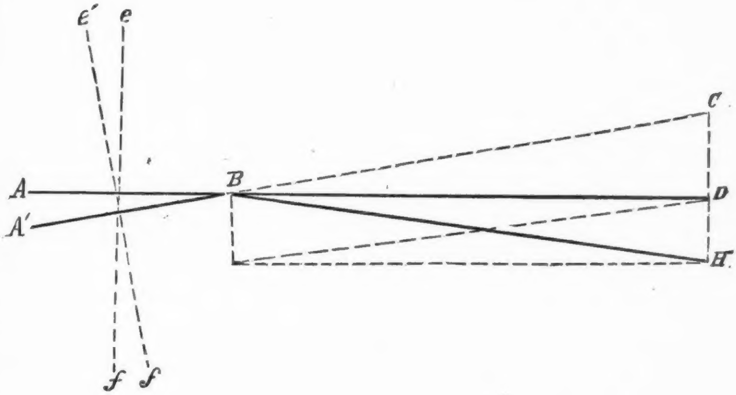
If motion in the direction 2 were resisted to the point of prevention, all the force, *e f*, would do work in the direction *c d*, when the entire sixty pounds would be setting up air pressure, and the plane would be in equilibrium in the direction 1 2. A very small force, say one or two pounds, would now drive the plane in any direction, say towards 1, with considerable velocity.

It is obvious that the sixty pounds of air pressure would be enough to supply the twelve pounds needed to balance the force acting towards 2, and the one or two pounds additional needed to drive the plane towards 1 with a velocity we will suppose of 150 feet per second. If we suppose the motion of the plane in the direction *e f* to be at the rate of thirty feet per second, it will move in opposition to the direction of the force as fast as it does with its direction, and we will have the anomalous case of a force developing enough force in moving a body to move several such bodies through the same space in the same time diametrically opposite to its own direction !

This seems absurd, and needs rectification to make it tolerable. We have entirely overlooked the fact that the moment *e f* began the task of working it abandoned the direction in which it resided, and four-fifths of it went over 18° to *c d*, and one-fifth went over 108° to *A B*. The direction *e f* is vacated, it is without significance. For all the influence it has on the plane it might as well not exist. There is *now* no movement of the plane against the direction of the force whatever. *Now*, the forces working on air, and driving the plane towards 1, are at right angles to each other and do not resist each other. The problem is, the ability of a force to drive a plane faster edgeways than flatways through air.

In going over, the one fifth that traveled 108° was wasted, *i. e.*, it neutralizes an equal amount of the other, so that only forty-eight pounds, instead of sixty pounds, are available to drive the plane edgeways; but this would be competent to produce an enormous velocity. Had the force been originally in *c d*, the entire sixty pounds would have been available.

But when we rectify the diagram so as to make *e f* vertical, and add two pounds weight to the plane, so that the force employed will be gravity, all the ghosts, which we supposed laid, at once reappear in vastly magnified proportions. The outcry now is, that the law of falling bodies is violated, for a body in falling can do no more work than sufficient to lift it through the same



perpendicular height. It seems that here is a good place to establish an exception, and we will examine into the way in which it may be done.

While the plane *A B* is level, the gravitating force is not resolved by it, but acts at right angles to the surfaces, when lateral motion will be resisted by nothing but atmospheric friction, and this the one or two pounds is competent to overcome, driving the plane to *D* while it is falling the thirty feet in which the sixty pounds is developed. It will therefore pass to *H*, the resultant of the two motions. It will simply have a lateral motion of 150 feet edgeways through the air added to its fall of thirty feet. To its work of air compression there will be joined an additional item of work in overcoming 150 feet of atmospheric friction. The

force developed in the fall will be enough to supply the lateral force and still leave fifty-eight or fifty-nine pounds to go to waste by falling to the tension of the surrounding air.

But this would not be "soaring," as the plane will soon reach the ground.

If we now throw the plane over on an incline of one in five, or 18°, we have an additional twelve pounds of lateral resistance to overcome, which the sixty pounds is entirely competent to effect, together with the one or two needed to carry the plane to *c*, and still have forty-six or forty-seven pounds more than is wanted left over. We now have the plane elevated as fast as it falls, so that its resultant passage to *D* is the horizontal translation of flight, and a body in falling does work enough to not only lift it to the same height from which it fell, but to move it against air resistance, and have a large surplus left over!

This seems impossible. But the reason of such appearance, as already shown, is that we are entertaining a fallacy. We are supposing the direction of the gravitating force to still be vertical after it has gone over eighteen and a hundred and eight degrees. We have, as a matter of fact, changed the direction of gravity more than we have slanted the plane. One-fifth of its total amount has gone over 108°. The plane has taken the same liberty with the great cosmical force of gravitation that it would with any other force. It refuses to be operated upon by any energy whatever of a mechanical kind while doing work on elastic fluids, excepting in the two directions mentioned, and any force whatever, not in either of these, is instantly put there by the plane. To say that the gravitating force is still vertical, and has not gone over, is to increase the difficulties of the case and not to abate them. In such event the law of fluid pressures is violated, which demands that they be at right angles to the compressing surface. The plane would also fall vertically without lateral motion, all of which is impossible. *Some* force is actuating *A' B* in its own plane and normal to it. From whence comes it? There is but one source of supply. The plane has simply resolved gravity until its perpendicular line has been vacated, and re-located at right angles to the lateral force acting in the plane, which lifts no weight, and resists nothing whatever but friction. The plane, in its translation towards *c*, is moving towards *e*, but not towards *e'*. It is going contrary to the abstract

direction of gravity, but not contrary to the direction in which that force is now working, which alone concerns us.

The whole matter hinges on the ability of a plane to resolve the gravitating force as it resolves other forces. In doing so it does a very wonderful thing. It makes of gravity a continuous motive power. It introduces a new idea into our conceptions of things, and makes it imperative that we rectify our notions of the gravitating force so as to admit these facts, which we have not hitherto recognized.

It dignifies the soaring birds into the position of favored creatures of nature. They inhabit a universe of their own. The horizon of their world is not the level of the sea, but the incline of their own wings, which they can change at will. Their gravitating force is either in a straight line from their bodies towards the center of the earth, or the moon, or the sun, or any of the stars of heaven, indifferently, as it suits them, to sleep on the breeze, to play at gymnastics high in air, to enact the rôle of the highway robber, or to serenely float from zone to zone.

I have now presented the case of the soaring birds to the extent of my ability. The task could have been better done by a specialist in analytic mechanics, as it is in this sphere that its significance lies. The whole matter is extremely peculiar. In consequence of the throng of preconceived ideas which tend to cast the obscurity of night over the whole case, the evidence upon which it rests, although axiomatic throughout, is difficult to see. The mechanism also seems devoid of organization, a simple plane is all there is of it, and still it has the power to change the horizon of the world to suit its own purposes. It would be unwise to suppose that a device capable of doing this was not competent to give to man what he has long coveted, the power to navigate the air.

Certainly we must entertain two standards of horizontal, one the level of the sea, and the other the incline of the wings of the soaring birds.

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CAUSES OF FOREST ROTATION.

BY JOHN T. CAMPBELL.

IN a letter recently received from Dr. S. V. Clevenger, he mentioned a case coming under his own observation on the North Pacific railroad, in Minnesota, near Mille Lacs, where the railroad

company cut the pine timber off of their own alternate sections for railroad ties and other purposes. This pine forest was succeeded at once, to all appearances spontaneously, by oaks.

I have often heard North Carolinians say the same thing about old fields in that State, when abandoned as worn-out land, that some timber different from that which had been cut off when clearing the land at first, would spring up spontaneously, or appear to be spontaneous.

I can speak only for my own locality, not having observed any other. Here (West central Indiana) we have in many localities a prevailing species of timber, but no species that exist to the exclusion of all others, as is often the case with pine. But of our prevailing timber, or any other kind, sugar maple excepted, none seem to be reproducing their kind in their immediate vicinity. For reasons which will follow, I surmise that nearly all forest trees bear and shed leaves which are unfavorable to the sprouting and growing of their own seeds. The most notable instance I can now think of is the red cedar, introduced into this vicinity from the north and north-east about forty-five years ago for ornamental purposes. I don't remember at what age they began bearing seed, but I think as early as ten years, counting them to have been three years old from the seed when transplanted here. Until certain kinds of birds began to eat their seeds, they were not found growing wild in the forests. I do not know what birds eat the seed, but evidently all do not, else they would have been planted as soon as the parent trees bore seeds, which was not the case for fully fifteen years afterward. When these seeds pass through the craw and intestines of birds they are prepared to sprout when they come in contact with the ground of the proper degree of moisture. Nurserymen, when they gather them direct from the trees, are obliged to put them through some process of scalding before planting. The birds drop them promiscuously over the country, where they have been appearing within the past fifteen years numerously, and only rarely before about that time. They are a hardy tree, and bid fair to become one of the forest trees of the future in this part of Indiana. It is reasonable to presume that these seeds would be more abundantly dropped under and very near these parent trees than elsewhere, for quite probably the birds that nest in these trees eat their seeds. Yet no young cedars are ever seen to sprout and grow there.

The same is true (*i. e.*, not growing their young within the radius of their leaf-fall) of the white pine, firs and other evergreens transported here for ornamental purposes. Some of the older ones are twenty inches in diameter, and have borne seeds many years.

I have long observed that the seeds of forest trees shed upon the forest leaves, sugar maple excepted, cannot sprout. This is very specially the case with the American poplar seeds. Yet I often find in the woods clusters of young poplars, varying in age from one year to sixty and seventy years. Last year I found out how this comes about. If the seeds happen to fall on the bare ground of the right degree of moisture, they at once take root and grow. If about the time these seeds are falling there should be a hog in the woods and he should have an appetite for ground worms, he would thrust his strong snout through the leaves into the ground and cast up fresh earth in a very promiscuous manner, and every poplar (or other) seed that should happen to fall on that fresh ground would stand a good chance of growing. I saw young poplars just barely sprouted under the above circumstances, while at the same time other and brother seeds had fallen on the leaves near by, where they lay dead and as dry and crisp as smoking tobacco.

Sometimes squirrels, hares, ground squirrels (chipmunks) dig through the leaves into the ground for food which they find there, I presume, and these places give a chance for one or more seeds to grow, and the hoofs of heavy bullocks (and in times past the elk and buffalo) have made deep tracks through the leaves into the ground, which would give a like chance, whilst the coating of leaves would prevent the growth of all the rest. The hogs were brought here at the very earliest time of settlement, turned loose in the woods, where they multiplied rapidly, becoming wild, ferocious and more dangerous to man than bears, wolves or panthers. Many of these clusters of poplars correspond in age to this time.

In Rockville, Indiana, where I reside, the river-bottom soft maple is very generally planted for a street shade-tree, mainly because of its rapid growth. Many of these are ten to twenty inches in diameter at the butt, and have been bearing seeds for years. The seeds of this tree must find favorable growing conditions as soon as they fall or they are lost, for one day's baking in the hot sun kills them. They must have a steady moisture

with warm but not hot sunshine. The trees bore a bountiful crop of seed last May, and of the first that matured and fell, I tried to sprout about a dozen by placing them in good ground and watering every day for several days. But as I could not give them all my time, they dried up between waterings and died. After these had died, there came a threatening, blustering storm one Sunday evening about sundown, which shook off the remaining soft maple seeds. They were so abundant that they gave the streets a buff color where they fell. The wind was followed by a light, steady rain, which continued several days, alternating with sunshine. This was favorable to sprouting these seeds, and they came up all over the streets, yards, and gardens as thick as weeds in a neglected field, a thing that never happened before in the twenty-two years I have resided in the place. Those in the street the cows ate up; those in the gardens were weeded out, and those growing elsewhere were killed by the following summer drought. On the south end of my garden, where a cellar drain terminates, the proper moisture was maintained through the drought, and there stands a thick cluster of them, the only survivors, so far as I know, of the millions that sprang up last May. After these trees are three years old they can be successfully transplanted into any kind of soil we have here, and seem as hardy as any dry-ground tree; but during their infancy the conditions *must* be as before stated or they die. So I think it is clear that this tree will never be self-planting, except along the low, moist bottom of the streams where we find it native.

The hard sugar maple does plant its own seeds within the radius of its own leaf-fall. In 1884 there developed a local rain in the south-east quarter of this (Parke) county which continued showery for several days, alternating with sunshine, just as the sugar maple seeds were falling. The result was as in the case of the soft maples last May; all the seeds sprouted. As this favorable condition did not happen when the other trees were shedding their seeds, the result in that part of the county is, that the sugar maples are a hundred to one of all the other young trees combined, and the deep snow and cold winter that followed, making a hard crust on the snow, prevented the sheep, cattle and rabbits (hares) from browsing them down, though it starved thousands of rabbits, as their bones found in hollow logs and trees abundantly attest; but it saved the young sugar maples till they are

now large enough to be safe from every enemy except man. If he were out of the way for 150 years about all the present forest trees will have lived out their time, and these young sugar maples would be almost the only trees of the forest in the area where a rain happened to fall with the seed. In the other three-quarters of the county that state of things would not exist, for there only the lucky seed that fell where a hog had rooted or a bull had trodden has made a tree, and this luck was as favorable to other seeds as to the sugar maple. These maple seeds send rootlets right down through the coating of leaves into the ground, and I have seen, over an area of many acres at a time, a maple sprout for every four inches square, or nine to the square foot, none seeming to have missed sprouting. In replanting the ground where the present forest has been cut away, the sugar maple makes the least show of all the forest trees. As an infant it seems to thrive best in the shade of older trees.

How the oak can take the place of pine where there are no oaks in the vicinity to bear acorns, I am not sure, but it is easier and more rational to believe that there is some natural agency for transporting the seed of the apparently spontaneous new tree, than to believe it to be really spontaneous, whether we understand the transporting agency or not.

One of the most industrious and persistent seed-transporting agencies I know of is that ubiquitous, energetic, rollicking, meddlesome busybody, the crow. Did you ever take a young crow and raise it as a pet? Please do so once and you will have more information about crows than I could give you in an entire number of the NATURALIST. They become very tame, and after they are able to fly it seems to be the delight and work of their lives to pick up and carry from place to place any and every article which is not too heavy for them. After a pet crow has had a little practice he is as expert at tricks of legerdemain as a showman. He will steal a spool of thread, a thimble, a pair of scissors, a paper of pins, or what not? right before your eyes, and as he flies away will tuck it so adroitly up under his tail feathers that you can't see it. He makes a deceptive grab as he starts to fly, by taking a few steps as if to give himself a little momentum to start his flight, and one of these steps he will plant square on the article he intends to steal, when his claws close round it and off he goes. Perchance he will alight only a few yards distant

on the ground beside a chip, which chip, as he alights, he will so quickly and adroitly turn over with the other foot as to cover out of sight the article he has taken. He will then take a few steps about the chip with his toes all properly radiating, purposely to show you that he does not hold the missing article in his claw. Unless you are acquainted with his tricks you would concede that he had not taken your thimble, so adroitly is the trick performed. Then he is ready for some new mischief. Off he goes to the chicken-yard where a hen and her chicks are scratching for bugs. He alights plump into their midst. The little chicks scream and scamper for shelter. The old hen, with her feathers all awry, dashes at him as if she would tear him into strings, but just as she gets in striking distance the crow opens his mouth and caws loudly right into her face. She stops abruptly, hesitates and slowly backs off. Then comes the cock of the yard, like a charge of cavalry, to drive the intruder from his premises; but as he too gets in striking distance, the crow opens his mouth about three inches wide and caws so loud, right into the cock's face, that he can be heard a quarter of a mile. The cock too stops suddenly, and his look of surprise and amazement is most amusing. His wrothy feathers gradually smooth down and he takes a few steps cautiously backward, then whirls and runs back under the rose-bush and there tells the hens how the crow acted, like Irving's Knickerbocker soldiers who were sent up the Hudson to capture a fort, and who had nose, thumb and fingers all wiggled at them at once over the wall by the garrison, which was such a strange and unexpected proceeding that they hastened back to headquarters to report what had taken place.

I had a pet crow two years ago that cut so many tricks in his way that a neighbor shot him one morning. Afterward, in cleaning the leaves out of my eave troughs, various of our own and our neighbors' articles were found in the troughs and on the roof.

The crow in his wild state is all the time busy at some such work as I have described. I cannot discover that he has any design in this busy, meddlesome mischief. If there is design in his work it is back of the crow in the Great Superintendent of nature's processes. I have seen crows gather by hundreds and have a regular pow-wow, a mass convention where they seemed to discuss measures and appoint officers. I have heard their cawing

more than a mile distant. At length they get through, by finishing their work or tiring of it, and disperse. As they start to fly away many, if not all, will drop something. I have found these to be acorns, walnuts, hickory-nuts, buckeyes, sycamore-balls, sticks, egg-shells, pebbles, &c. As a crow leaves an oak he will pluck an acorn which he may carry five miles and light on a beech tree, where something else will attract his attention, when he will drop the acorn and may be pluck a pod of beech nuts and fly away somewhere else.

The squirrel is also a nut-transporting agent. The hog will eat his nut where he finds it, but the squirrel must find some suitable place to eat his nut, like some fastidious boarders I have known, who would not and could not eat if they failed to get their own conspicuous place at table. The squirrel will select his nut, take it in his mouth, skip along a few yards, pause a moment, then a few more skips and pause, preferring a fence or fallen tree to the ground for his roadway. He will sometimes carry his nut several hundred yards, not to his home, but to some conspicuous tall fence-stake or dead projecting limb of a tree, on which he sits on his haunches, his tail curled over his back, and in this striking attitude he complacently gnaws through the shell of his nut to get the kernel. It will sometimes happen that just as he is ready to begin on his nut a hawk will swoop down after him, and His Complacency is glad to drop his nut and flirt down to the under side of the limb for protection. This nut may fall on good ground and make a future great forest tree. He will be chased by a dog, fox or hawk sometimes while on his way to his eating place, and involuntarily plant an oak, a walnut or hickory. The partition fences across our cleared farms and stumps out in the fields have many such planting of oak, walnut and hickory, far from the trees that bore the nuts, which I attribute to the crow or the squirrel.

I know a place about four miles south-west of here, where a low place in a field was too wet to be plowed, and has grown up full of young bur oaks, but there is no parent tree anywhere near, not near enough even for high winds to carry such acorns. Such acorns sprout only in wet ground. I think this grove of bur oaks is the result of a frolic of the crows. They had a previous frolic on a bur oak, and in leaving it for this place, each carried an acorn, as is their habit.

OBSERVATIONS ON YOUNG HUMMING-BIRDS.

BY H. S. GREENOUGH.

DURING the month of June last, I heard through friends of the nest of a humming-bird (*Trochilus colubris*) at Cotuit, on Cape Cod, where I was then staying, and having long wished for such an opportunity, I immediately decided to do what I could towards observing the growth of the young. Unfortunately the position of the nest made this rather difficult, for it was on a small dead branch of a yellow pine tree, some distance from the trunk and twelve to fourteen feet from the ground, or thereabout. Of four nests that I have seen, all in Cotuit, three were in yellow pines and one on a silver poplar, two about twenty or twenty-five feet high, one nine or ten and the last as above stated; the one on the poplar was on a small dead branch; with regard to those that were highest up, I do not remember whether they were on dead limbs or not.

The young birds were first seen by me on a Saturday, the previous Wednesday a lad, whom I sent up the tree, reported two eggs, as he had already done once before, so that I cannot say when the birds were hatched, and had feared to make daily visits at this stage lest I should frighten away the old bird. By means of a long step-ladder, improvised for the occasion by tying together two ordinary ladders, I was enabled to view the young within a few inches. Though very small, they were rather larger than I had expected them, and appeared to be already covered for the most part, a bare streak extending, however, down the middle of the back; *the bills were very short and of wide gape and yellow*, and the general appearance of head and bill was decidedly swift-like, but whether the bill was of the full fissirostral type, *i. e.*, gape extending to below the eye, I am not sure. I feared to take the young out for

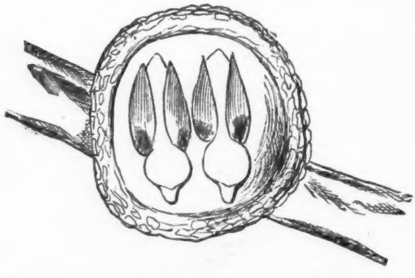

FIG. 1.—Diagrammatic sketch from memory of young when first seen. A trifle reduced; heads too small in proportion to bodies.

closer inspection lest I should injure them or frighten off the old bird, and I particularly wished to ascertain other points which could only be done by leaving the nest undisturbed. The two young lay quite still at the bottom of the nest (which was deeper than those I have seen after the birds have left, and with sides and edge beautifully finished) with their heads pointing the same way and their bills somewhat upward and against the side of the nest. The annexed diagram, from memory, will give a fair idea of their general appearance at this time, it being borne in mind that special attention was paid to the head and bill.

On the following Thursday I again went up to the nest, and found the birds somewhat grown and the typical humming-bird bill beginning to show itself. I can best describe it by saying that it looked somewhat as if it had grown out of or on to the other like an extraneous thing, but was still only a fraction of an inch long, say a quarter or trifle less. During this time the old bird had been on the nest nearly always when I passed by, or if away was very soon back. A few days later, however, I found her absent for some time, at different hours of the day, and feared some accident had happened, but on watching near by I finally saw her return and feed the young and then sit on the nest again. I now borrowed an opera-glass and passed a good deal of time watching the feeding of the young. When first seen the old bird perched on the edge of the nest in an erect attitude, very much as a woodpecker on the trunk of a tree, and bent down her bill close to her nest whilst feeding the young; later on the position was varied, sometimes sitting nearly horizontal and feeding a bird on the opposite side of the nest. After the young got a little larger she could be seen to thrust her bill into theirs; she fed first one and then the other, apparently by regurgitation from the crop, for a motion could be seen in the region of the throat, and after feeding one she would hold up her head for an instant before feeding the other. In a few days she ceased to brood the young, but fed them very frequently. I often saw her fly to the nest, and when she had gotten near she would generally poise and look round before perching on its edge. On going away she would sometimes fly off immediately till out of sight, at others would alight some twenty to forty yards off and stay for

FIG. 2.—Diagram of young humming-bird's head on Thursday, *i. e.*, sixth day it was seen. From memory.

a few minutes, and then away as before. She did not appear to mind my presence much, if at all, though I was quite near, within thirty feet and sometimes much less, say fifteen or seventeen, *i. e.*, almost directly under the nest. At no time did I see the male bird come about the nest. Some ten days or thereabout after the young were first seen, their bills began to show above the edge of the nest, and soon after were generally plainly visible.

On the morning of the fifteenth day after the birds were first seen, one of them was observed to flutter its wings just a little for the first time. I now judged that the birds would soon leave, and accordingly passed several hours every day under the nest.

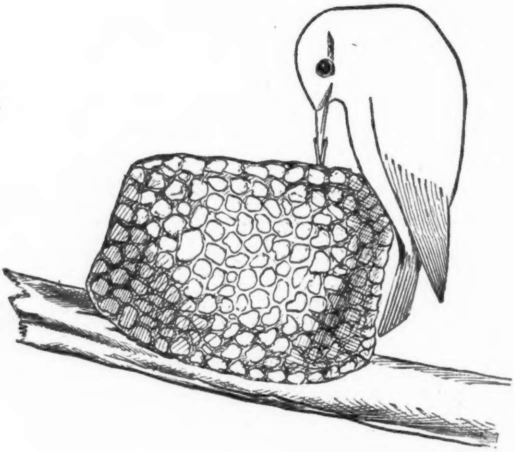

FIG. 3.—Humming-bird feeding its young; copied from pencil drawing made on the spot in summer of 1885.

The restlessness of the young increased; their heads generally showed above the edge of the nest, they looked about and frequently turned round, and every now and then one would flutter its wings, or sometimes only spread one or both; this phase was very interesting to observe on account of the progressive activity shown, and that without leaving the nest at all. By the following Wednesday the restlessness had increased very much, the birds raising themselves somewhat and the motion of the wings being very rapid, producing a gauzy, halo-like appearance as in old birds. The following morning, Thursday, *i. e.*, the twentieth day,

I saw one of them raise himself on "tip-toe" and, fluttering his wings, get upon the edge of the nest and then down upon the branch, sit there a moment, and then back into the nest in the same way. I watched all the morning, but neither bird left the nest, though both seemed very restless; on my return in the afternoon only one young bird remained. I saw the old one feed him once or twice, and noticed that she approached him from a different direction to what I had before seen, coming downwards from the clump of pines, on the edge of which stood the nesting tree, instead of the open glades from which I had always before seen her approach. I accordingly laid on my back and looked upward, and presently saw her return and perch on a bough beside another humming-bird, feed it and fly away. I now watched the bird on the bough very carefully and soon saw it fly, and this it did repeatedly at short intervals, sometimes down, again up, on a level and in curves; except for the shortness of its flights, I could see no difference from that of the old bird (and as it was well grown, had I seen it casually I should not have known it for a young one); there appeared to be the same precision of movement, facility of turning and rising, and the same humming style of flight, though I was not near enough to hear any sound. Once toward the end of an unusually long flight, I thought, I perceived signs of fatigue, but do not feel sure of this. The second bird continued in the nest, and was still there on Friday morning and again in the afternoon, the other bird being in the neighboring trees, flying perfectly, and both frequently fed by the old one. On Saturday morning the second bird had also left, and all three birds, if I remember rightly, were observed in and about the neighboring trees. I now tried to get some pots of flowering plants to place near by, and determine, if possible, how soon the young would begin to feed themselves, but did not succeed in obtaining any, so that I could not ascertain this point.

I frequently heard a faint chirping just before or during feeding, but do not know if made by old or young, or both, though, as when feeding the flown bird, I once saw the old one seek him some little time, he having changed his place, and heard the chirping. I am in this case inclined to think the young bird must have made the sound, and perhaps the old one also.

I once saw the old bird thrust her tongue out, and to a much greater distance than I should have supposed.

I was unable to secure any photographs, though a friend kindly tried to take some for me, our ladder proving too short to admit of getting the camera into position for focussing; but the rough drawing made on the spot with the aid of an opera-glass may give a better idea of the feeding position assumed by the mother bird than my description has done.

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THE MECHANICS OF SOARING.

BY PROFESSOR J. E. HENDRICKS.

As Mr. I. Lancaster has published, through the medium of the AMERICAN NATURALIST, his very interesting and valuable observations of soaring birds, and has, in the April number (No. 4, Vol. xx) given an explanation of the mechanics of soaring that might lead non-technical readers astray, a brief review of the "Mechanics of Soaring" may not be unprofitable to some of the readers of the NATURALIST.

As much that Mr. Lancaster has said is in accordance with the recognized principles of mechanics, I will not encumber the pages of the NATURALIST with a general review of the whole article, but will confine this paper mainly to a consideration of the question proposed by him and which he regards as a crucial test of the validity of his theory of soaring.

In investigations concerning the operation of forces, it is important that the distinction between continuous and momentary forces be kept in view. Although all forces require time for their operation, yet such forces as act for a short time and then cease to act, are called *momentary* forces, and the time during which they act is not considered; the velocity induced being constant and equal to the intensity of the force divided by the mass.

When a force acts uniformly for a considerable portion of time, it is called a *constant* force, and the time of its action is involved in the velocity it induces, which is represented by the intensity of the force multiplied by the time and divided by the mass or weight of the body.

Although we do not know what produces the phenomena of gravitation, we know, as manifested on the surface of the earth, it is a result of two opposing forces (a centripetal and a centrifugal force) whose difference at any point on the earth's

surface is indicated by the weight of the body at that point. Weight, therefore, or gravity, is a constant force, and differs in no respect from any other constant force.

It is found by experiment that a current of air, having a velocity of thirty feet per second, and meeting a stationary plane, the projection of which, in the direction of the motion, has a superficial area of one square foot, exerts upon the plane, in the direction of the current, a force $= 2$ lbs. $\times \sin^2 \theta$, where θ denotes the angle which the plane makes with the direction of the motion; and for different planes the force is approximately proportional to the areas of the planes, so that on a plane one foot wide and six feet long, as supposed by Mr. Lancaster, when the current is normal to the plane, the force exerted upon the plane by a velocity of thirty feet per second will be twelve pounds. This is the value of the special force assumed by Mr. Lancaster, and whether we consider the twelve pounds pressure as resulting from a constant atmospheric current or any other cause is obviously indifferent.

If then we suppose the weight of the plane to be twelve pounds, and its descent vertical through a quiescent atmosphere, while the plane surface is horizontal, the case will be that of a falling body in a resisting medium, and when the plane shall have acquired a velocity of thirty feet per second, we know, from the experiments above referred to, that the plane will meet a constant resistance of twelve pounds, and this being the weight of the plane it will thenceforth descend with the uniform velocity of thirty feet per second.

If while thus descending, in equilibrium, a momentary horizontal force, the intensity of which is equal to gravity, be impressed upon the plane, because it would impart to one pound a velocity of thirty-two feet per second, it will therefore impart to the plane, the weight of which is twelve pounds, a velocity of only $\frac{1}{12} \times 32$ ft., or $2\frac{2}{3}$ ft. per second, instead of 1000 ft. per second as assumed by Mr. Lancaster.

If now the plane be tilted so as to make an angle θ with the vertical, the vertical pressure it will encounter, when the velocity is thirty feet per second, will be $12 \cdot \sin^3 \theta$ lbs., and because its weight remains the same the plane will cease to be in equilibrium. An increase in the velocity of the descent of the plane in the ratio of $\sqrt{\sin^3 \theta} : 1$ would restore the equilibrium and the plane

would descend along the "rest" with the uniform velocity of $\frac{30}{\sqrt{(\sin^3 \theta)}}$ feet per second.

We are now prepared to answer the query proposed by Mr. Lancaster as a crucial test of the validity of his theory, viz., "Will the tilted surface, supplied with the rest of two pounds and moving with uniform velocity, obey the impulse of an external force applied in its own plane with equal facility in any direction?"

The above formula for uniform velocity of descent indicates that, for all inclinations of the plane, there is an unbalanced force which acts downward and parallel with the face of the plane, and therefore toward the "rest." The tilted surface therefore will *not* "obey the impulse of an external force applied in its own plane with equal facility in any direction."

"The implication of the case" therefore is, that if an inclined plane is free to descend through the atmosphere, by virtue of its weight, it will, in consequence of the atmospheric resistance, move *laterally downward* unless it encounters a *current* of air that, being resolved by the under surface of the plane, gives a vertical component which is equal to or greater than the weight of the plane, in which case the plane will move horizontally or ascend; or if the plane is properly shaped it may, in consequence of "rear expansion" of the air, remain stationary with respect to the earth.

It follows that all of the observed phenomena of soaring are in accord with the recognized principles of mechanics, but I trust it is sufficiently obvious, from the preceding discussion, that a soaring bird is *not* "translated at right angles to the gravitating force, or horizontally, solely by the action of that force."

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EDITORS' TABLE.

EDITORS: A. S. PACKARD AND E. D. COPE.

—— Just as the inorganic appears to have preceded the organic in the history of the phenomena of nature, the inorganic preceded the organic as the most potent factor in the environment in which organic nature developed. Convulsions of inorganic nature were frequent and irresistible in the most ancient periods of time, and they diminished in number and importance as life

varied and multiplied. The conditions of the fitness essential to survival were thus originally those of physical endurance, and as life multiplied and inorganic nature receded in importance as a factor, these conditions came to depend more and more continually on intellectual development or adaptation to the wants of the most intelligent organisms. The most useful and successful man in the Plymouth Rock colony was he of the strongest arm and broadest shoulders, but the most useful and successful man of the metropolis to-day is he of the greatest business tact and shrewdness and the broadest human sympathies.

When we speak of the "survival of the fittest," it is obvious that we must keep before our minds a clear idea of the sense in which the words "survival" and "fittest" are used. If the conditions of a certain sense of the word "survival" pass away or indefinitely decrease in relative importance, we cannot reasonably expect to apply the word in that sense as if it were invariable. It is necessary, instead, to employ a more constant and general signification of the word.

If there were no universal and overwhelming convulsions of nature after the arrival of the highest members of the scale of animal life at a plane of absolute intelligence, we are warranted in supposing that the most intelligent mammals, at least, were capable of preserving themselves from destruction and burial by the lesser convulsions of nature that occurred from time to time.

Moreover, if we assume, for the sake of argument, that man descended from the highest development of anthropoid apes whose existence in prehistoric times is known, we must admit the occurrence of a considerable interval between the cessation of such convulsions of nature as were likely to bury and preserve the remains of anthropoid apes and the attainment by the anthropoid of a sufficient degree of intelligence to suggest the burial of the dead in a manner calculated to preserve their remains for modern scientific inspection.

The longer this intermediate period is supposed to be, the greater the intellectual development which, under the laws of evolution, should take place in the course of it. The reasonable inference is that the greater the gap between the highest known form of anthropoid ape and the lowest known form of man, the more important, relatively, must have become the social and moral conditions of development, while the physical conditions

dwindled in importance during the period represented by that gap.

If, mathematically speaking, we let m represent the product of physical conditions in effecting the variation and development of the organism, and n the product of social and moral conditions, we find that m varies inversely as n. If m be infinite and n infinitesimal, as at first, and m continually diminishes while n increases according to definite laws, the attainment of a point at which m is infinitesimal and n infinite is only a question of time.

The conditions of any possible development of man from anthropoid apes appear therefore to require that there *should* be a "missing link," in the sense that physical evidences of intercalary types are unpreserved. The "survival" of the fittest, at a certain period in the history of life, means exactly such survival as would make it improbable that many remains should be preserved, and this survival only the fittest would, under the circumstances, attain. Such anthropoid apes as were capable of generating man should have been superior to those whose remains were preserved because they had not intelligence enough to protect their lives. The first considerable preservation of primitive man would begin when he ventured on navigation; but his remains so preserved will be "missing," until such time as "the sea gives up her dead."

—— The committee of Congress which has been investigating the U. S. Geological Survey has not dealt kindly with Major Powell and his charge. There is no intrinsic reason why Congress should not be favorable to the Geological Survey, but there is probably no department where it is less likely to tolerate abuses. We cannot say that the survey has been entirely free from faults of this kind. If Major Powell is carrying any Jonahs he had better relieve himself of them.

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RECENT LITERATURE.

A HAND-BOOK OF PLANT DISSECTION.[1]—This long-promised work has at last appeared, and we have no doubt that it will be welcomed by laboratory workers throughout the country. It is apparently an entirely original work, no statements being made at second hand, and no directions for work being given which have not been *actually worked out* by the authors themselves. One finds evidence of this original work on almost every page, and this fact alone will commend the book to all teachers and to every pupil who wishes to become an investigator in structural botany.

[1] *Hand-Book of Plant Dissection.* By J. C. ARTHUR, M.Sc., botanist to the New York Agricultural Experiment Station; CHARLES R. BARNES, M.A., professor of botany in Purdue University, and JOHN M. COULTER, Ph.D., professor of botany in Wabash College; editors of the *Botanical Gazette.* New York, Henry Holt & Company, 1886, pp. XXII, 256, 12 mo, with two plates.

PLATE XX.

Wailuku—Maui.

The book opens with two plates, illustrating (1) gross anatomy and (2) minute anatomy, and the methods of recording results by means of the pencil or drawing-pen. This is followed by a chapter on instruments, reagents, section cutting, mounting, etc., etc., in which the treatment is refreshingly non-technical. There is a suggestive absence of the usual "microscopical" lingo, and a plainness of statement which cannot help pleasing every reader.

The succeeding chapters take up in order the following plants, viz., green slime (*Protococcus viridis*), dark-green scum (*Oscillaria tenuis*), common pond scum (*Spirogyra quinina*), white rust (*Cystopus candidus*), lilac mildew (*Microsphæra friesii*), common liverwort (*Marchantia polymorpha*), moss (*Atrichum undulatum*), maiden-hair fern (*Adiantum pedatum*), Scotch pine (*Pinus sylvestris*), field oats (*Avena sativa*), trillium (*Trillium recurvatum*), shepherd's purse (*Capsella bursa-pastoris*). A chapter is devoted to each plant, and in the treatment the gross anatomy is first taken up, and afterwards the minute anatomy. Preceding both, however, is a short statement giving such general facts as to habitat, appearance, structure, development, etc., as will enable the student to find the plant and undertake its study with less difficulty.

It will be observed that the work proceeds from the simple to the complex, and that every great branch of the vegetable kingdom is represented by species which may be obtained easily in in any part of the country. The authors have exercised unusual care, as it appears to us, in this matter, and have succeeded in making a list of illustrative plants which even a tyro will have little difficulty in securing wherever he may happen to be.

We would direct the attention of those who are skeptical as to the possibility of beginners studying the lower forms of vegetation to the gross anatomy studies under each species. The things which can be seen in every one of the lower plants will astonish the old-fashioned teacher. Even in the two protophytes (Protococcus and Oscillaria), the authors coolly set the student at work, *first*, with nothing but his unaided eyes, or at most with a simple hand-lens; and he is expected to find out a good deal, too, by such means. We venture the assertion that, considering the almost infinitely greater complexity of shepherd's purse over Protococcus, the latter has far more which can be made out by gross anatomy than the former. If the student can see little in Protococcus with his unaided eyes, or with a hand-lens, it is because there is very little to be seen. The old adage, "a short horse is soon curried," is appropriate here. One must not expect to see as much in Protococcus as in Capsella, but one must not neglect to see the little that is to be seen.

An excellent pronouncing and descriptive glossary, and a full index, complete the volume.—*Charles E. Bessey.*

THE FOURTH ANNUAL REPORT OF THE U. S. GEOLOGICAL SURVEY.—Besides the usual reports showing the progress in the survey by the different members, the body of the volume is filled by the following memoirs: Hawaiian volcanoes, by Capt. C. E. Dutton; Abstract of report on the mining geology of the Eureka district, Nevada, by J. S. Curtis; Popular fallacies regarding the precious metal ore deposits, by A. Williams, Jr.; A review of the fossil Ostreidæ of North America, by Dr. C. A. White; A geological reconnaissance in Southern Oregon, by I. C. Russell.

Having already called attention to Dr. White's valuable essay, we would briefly notice Capt. Dutton's elaborate account of the volcanoes of the Hawaiian islands. Besides detailed descriptions, accompanied by excellent illustrations and maps, of Kilauea and Mauna Loa, the author also describes Mauna Kea and the old extinct volcano of Kohala and the lava fields of Hualalai.

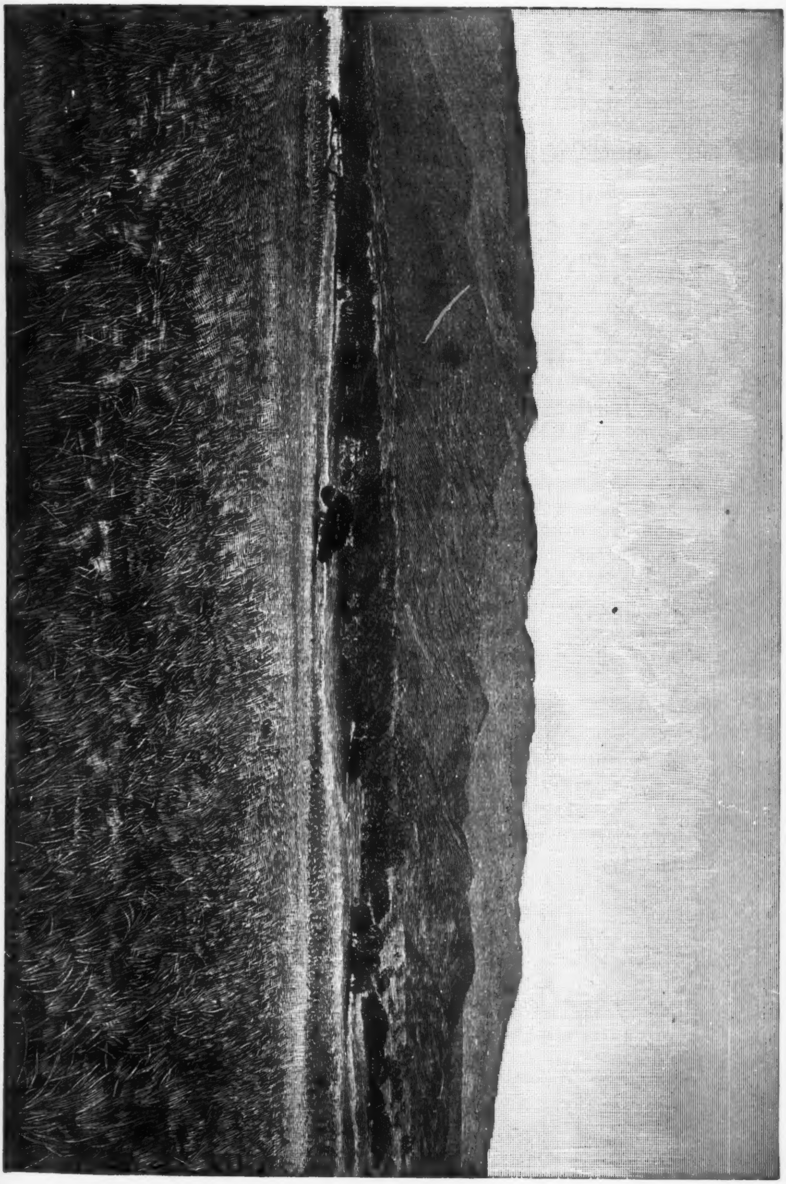
The descriptions of the mountains and lava streams and beds are careful and the facts presented will be important to the student of vulcanism. The author does not regard Kilauea as a crater, but considers the depression in that mountain, which he designates a *caldera*, as due to the "dropping of a block of the mountain crust which once covered a reservoir of lava, this reservoir being tapped and drained by eruptions occurring at much lower levels."

Acknowledging that volcanic action and regional uplifting are really associated phenomena, the author states that the cause is mysterious, the attempted solutions not standing criticism, though suggesting that the effects are due to expansion of the earth's crust in the region involved.

The three plates which we are allowed to reproduce from this volume, will convey some idea of the grandeur and beauty of this volcanic region.

THE ZOOLOGICAL RECORD FOR 1884.—This volume appeared promptly, our notice of it having been delayed. It forms the twenty-first volume of the series, and like its predecessors it is indispensable to all workers in systematic zoölogy, and it is to be hoped that its future publication will be maintained even though heavy sacrifices be made. While members of the Zoölogical Record Association and subscribers receive the volume for £1, the volume is issued to the public at £1 10s. The undertaking is partly supported by a grant of one hundred and fifty pounds from the Government Grant Committee of the Royal Society, and of one hundred pounds from the British Association, but still more subscribers are needed. The Record is now edited by Professor F. Jeffrey Bell, and there has been a number of changes in the list of assistant editors. We regret to notice that Professor E. von Martens, from the first the recorder of Mollusca and Crustacea, has been obliged to resign. His place is taken by

PLATE XXI.



Mauna Kea from the South.

four younger men. The work of compiling such a record as this is a great labor, but is a most useful task, and the results are a great boon to those situated away from libraries. To such the purchase of the Record is earnestly commended. It is published by Mr. J. Van Voorst, Paternoster row, London.

THE AMERICAN ORNITHOLOGISTS' UNION CHECK-LIST OF NORTH AMERICAN BIRDS.[1]—This catalogue of North American birds, as the latest issued, is the most complete, and will be a useful work of reference to ornithologists. The volume also contains a digest of rules of nomenclature adopted by the American Ornithologists' Union. There has always been a large proportion of authors of works on birds with literary rather than scientific tastes, so that the conclusions of an ornithologists' union will require careful scrutiny on the part of the scientific investigator. The danger from the side of letters is the subordination of the true interests of scientific research to red tape and literary archæology. The way to do this is to excuse authors from giving definitions to the new words they introduce, and so to open wide the doors to amateurism and its attendant confusion and redundancy. We are glad to observe that the new code agrees with the old ones in requiring that new generic names shall be defined in order to be adopted. But a few pages later the code contradicts itself by saying that when an author describes a new species which belongs to a new genus, it is not necessary to give a separate description of the genus, although a new generic name may be proposed. The code on this point therefore appears to us to be without authority either way, and we have to rest on the older codes, which require definitions in all cases. Nor do we find the code clear as to the necessity of furnishing definitions for divisions of higher rank.

Another objection we find is that it requires the use of an old specific name when the generic name later proposed is identical with it. Such names are really mononomial, and no more to be adopted than quadrinomial ones. The question is, however, rather one of taste, than of any serious moment.

Apart from these points we concur heartily in the rules of the code.

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Bureau of Education.—Report of the Commissioner of Education, 1883–'84. From the department.

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[1] New York, American Ornithologists' Union. 1886, 8vo, pp. 392. For sale by L. S. Foster, 35 Pine street, New York city. $3.

Baird, S. F.—Annual report of the Smithsonian Institution, 1883. From the department.

Hall, Jas.—Thirty-eighth annual report on the N. Y. State Museum of Natural History. From the director.

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——The oldest tarsus.

——The intercentrum of living Reptilia. These three Amer. Naturalist extras, 1886.

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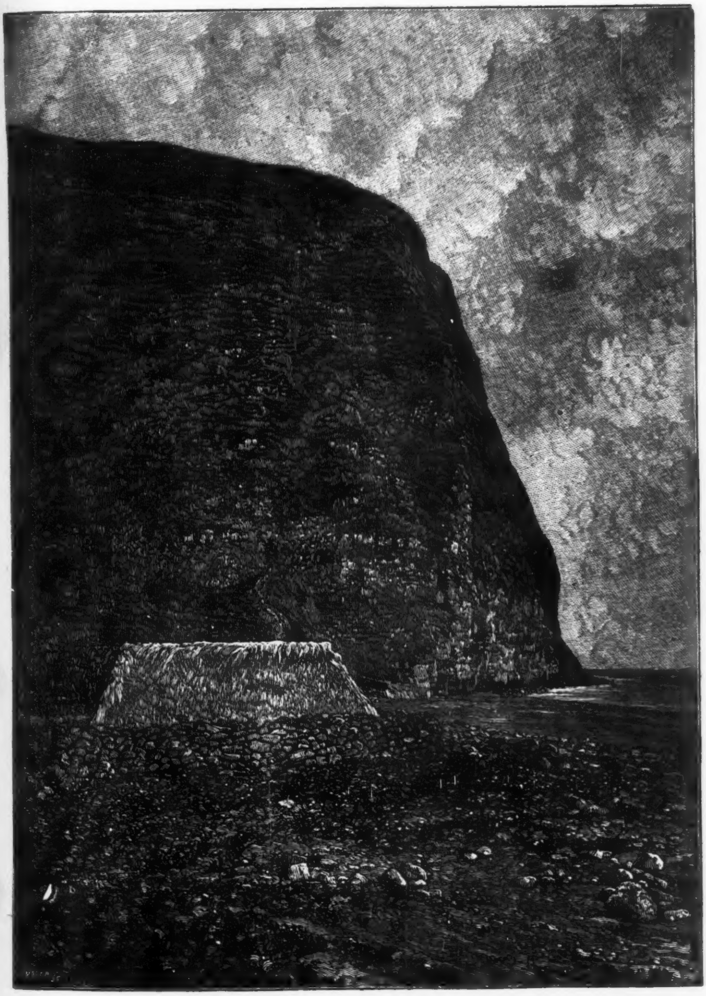
PLATE XXII.



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——Geognostische Excursion nach Dippoldiswalde, 30 Juli, 1885. Both from the author.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

ASIA.—*Railway Projects in the Shan Country.*—Mr. Holt Hallett states that the most practicable line for a railway in Indo-China, to connect India with that country, is up the valleys of the Meh Ping and Meh Wung, tributaries of the Meh Nam, to Kiang Hsen, on the Meh Kong. At Raheng this line would be joined by another from Maulmein, at the mouth of the Salween, in British Burmah. North of Kiang Hsen the railway would be produced along the Meh Kong valley to Kiang Hung, fifty miles from the Chinese town of Ssumao. By taking this route the mass of mountains lying east of the Irawadi is avoided.

The Burmese Shan States east of the Irawadi are believed to contain a million to a million and a half of inhabitants; the Siamese Shan States about two and a half millions, while the Meh Nam valley, south of the latter, has about three and a half millions.

The Shans are described as a cultivated people, free from caste, industrious and energetic, hospitable and frank toward strangers, eager for free trade, and of great capacity as petty traders. The hill-tribes are a hard-working, manly people, good agriculturists and handicraftsmen, great growers of cotton, tobacco, indigo and tea, and extensive breeders of cattle.

There are two races of Lua or Lawa, one of which, the "Baw Lua," is acknowledged to be the aboriginal race. They are found chiefly in the Maing Loongyee valley, and here number about nine thousand.

The Heri-rud Valley.—Dr. Aitchison, naturalist to the Afghan Delimitation Commission, states that the valley of the Heri-rud is extremely fertile, producing magnificent crops of wheat, barley, cotton, grapes, melons and the mulberry tree. Among the trees grown are *Pinus halepensis*, an ash and two elms. The country appears barren and arid in winter, but in spring is covered with

[1] This department is edited by W. N. LOCKINGTON, Philadelphia.

plants, which shoot from under-ground root-stocks, bulbs, tubers and rhizomes. Among these are the assafœtida plant (*Ferula scorodosma*), and other Ferulas, one of which yields galbanum, and another is taller than a man on horseback. Forests of pistachio are met with among sand-stone rocks. Manna is collected from a *Cotoneaster* tamarisk, and a thorny pea-shrub called *taranjabin.*

The earliest spring flowers are three Merenderas, followed by a many-colored tulip and several Eremuri (liliaceous). The golden flowers of a Delphinium are collected for dyeing silk yellow. More ordinary plants are two low Artemisias, two species of Ephedra, and numerous Astragali. An Asclepias, which sends up annual stems from an under-ground root-stock, yields a good fiber, which is made into cloth.

Asiatic Notes.—The *Calcutta Englishman* states that Mr. Needham and Captain Molesworth followed the course of the Brahmaputra from Sadiya to Rima, and are able to state authoritatively that the Zayal Chu falls into it.——The expedition dispatched to the Fly river by the Geographical Society of Australasia, in November last, has returned. Reports of the massacre of the party were circulated by two natives, who became panic-stricken at a time when the steamer was surrounded by hostile natives, who threw spears and shot arrows from the banks.——Petroleum appears to abound in Asia. It occurs in Burmah, also near Quetta (Hindustan), and the whole country, from the north-eastern corner of the Black sea, through the Caucasus to Baku on the Caspian, abounds with it.——There is much dispute about the title of Mount Everest, undoubtedly the highest known peak in the world. Mr. D. Freshfield maintains the accuracy of Schlagintweit's observations, and insists on Gaurisankar, "the bright or white bride of Siva," as the native name for the peak, while Devadunga, "the abode of Deity," is that of the group. General J. T. Walker denies that Mount Everest is identical with Gaurisankar. The first name was given by Sir A. Waugh, because no native name could be discovered. Herman Schlagintweit identified it with the Gaurisankar of the Nepalese, but from the description he gives it is obvious that he mistook Makalu (which is nearer to his point of view, and, though 1200 feet lower, appears higher, because of the earth's curvature) for Everest, which he calls Sihsur.

AFRICA.—*Mr. Kerr's Journey to Lake Nyassa.*—W. Montagu Kerr gives in the February issue of the Proc. Royal Geographical Society an account of a journey from Cape Town to Lake Nyassa. The traveler passed through Gubuluwayo, the capital of Lo Bengula, king of the Matabelé, by whom he was cordially received. The next people met with were the Mashonas, who as a race are inferior to the Matabelé. They file a triangular opening

between the front teeth, and are armed with bows, ax, and two or three assegais. The women shave the head. They are a persecuted race, dwelling in towns among the fastnesses of the igneous mountains. The next people visited, the Mokorikori, resemble the Mashona. Among the Senga, the women perforate the upper lip, placing therein a ring of ivory or wood, called the *jaga*. By constantly enlarging this, they succeed in making the lip project two and a half inches.

Tete, a flourishing Portuguese town in Livingstone's time, is now half ruined, for the elephant has retreated to the far interior, and the ivory trade is small.

After leaving Tete, Mr. Kerr was deserted by his followers and left alone among a tribe of kidnappers of mixed Zulu and Chopetta origin. The king has absolute power; executions are frequent, and nameless cruelties general. It might have fared ill with the traveler had it not been for a Portuguese hunter.

At length Lake Nyassa was reached, at the mission station of Livingstonia. The station was deserted, and the Ajawas, who remained with the traveler, would not risk their boats on the Shiré. After sixteen days in a deserted hut, he was rescued by M. Giraud, then on his way to the coast.

Lake Nyassa is many feet lower than in 1859, and the Shiré is diminishing in volume.

The Berbers.—M. Foncin (Revue de Geographic, Fevrier, 1886) states that the Berbers are the predominating race in Algeria. Phenicians, Carthaginians and Romans have disappeared, and occasionally the blonde type occurs in Kabylia, and recalls the soldiers of Genseric; the Arab tongue preponderates; yet even the Arab is merged in the ancient Berber race. There are, in fact, only two chief races in Algeria—Arabized Berbers, about 2,000,000 strong, and Berberized Arabs, about 800,000 strong. Moors, Turks and negroes are few and are becoming fewer, but Jews increase. The Berbers are often nomads, and were so in the time of Sallust.

The sedentary tribes are the Kabyles of the mountains east of Algiers, the natives of the Dahra, the Traras and Little Kabylia, the Aurasians of the Aurès, the highest mountain mass of Algeria, and the Ksourians or natives of the oases of the Algerian Sahara, including the people of Mzab. The Tuareg are nomad Berbers.

The Congo.—M. de Brazza thus summarizes the results of his last expedition, which covered a space of two years and nine months. The survey of the Ogowé has been completed; the Alima and the Congo (from the Nkundja to Brazzaville) has been thoroughly surveyed; important topographical and hydrographical work has been executed on the coast of Loango; numerous astronomical observations have been taken at different points; natural history specimens of interest have been extensively col-

lected and a large number of photographs, sketches and ethnographical notes have been brought home.

Almost all the tribes along and between the Ogowé and Congo have been brought under the influence of France, including, to some extent, the cannibal Fahuins.

Mr. Grenfell has made another exploring voyage devoted to the Lulongo and the Boruki, the only rivers of importance that remained unexplored between the Kasai and the Lomame. The Lulongo falls into the Congo in 18° 42′ E. long. and 0° 41′ N. lat. Mr. Grenfell ascended it to 22° 32′ E. long. and 10′ N. lat.; it therefore runs nearly parallel to the main stream. The Boruki is formed by the union of three rivers, one of which, the Juapa, was ascended as far as 23° 14′ E. long. and 1° 1′ S. lat., where it was still an open water-way one hundred yards wide and twelve feet deep.

AMERICA.—*American News.*—Explorations conducted in the Gran Chaco by M. de Brettes have resulted in the discovery of a large salt lake, situated between lat. 25° 57′ .06″ S. and lat. 27° 30′ 18″ S. Three rivers, flowing north and south, probably tributaries of the Vermejo, were discovered. The natives, Chunupis, Velolas and Matacos, are degraded, cruel and hypocritical. The country is flat, covered with thorny trees, marshes and tall, sharp prairie grass.——Dr. Ten Kate has explored the canal connecting the Surinam and Saramacca rivers, ascended the Wayombo, the banks of which are inhabited by the Arrowaks, proceeded for five days up the Nikerie, which flows through a well-wooded but uninhabited region, and returned down the Nikerie and up the Corentin to Oneala.——M. Thouar, according to the *Brazil and River Plate Mail*, has returned successfully from his second journey up the Pilcomayo, and has proved the river to be navigable.

EUROPE.—*European News.*—The German Statistical Bureau gives the population of Berlin in 1885 as 1,316,382. In 1880 Germany had only eight towns of more than 100,000 inhabitants, now it has fourteen.——The Dobruja has an area of about 5766 square miles, about two-thirds of which is productive, the rest marshes and sand with lakes. The official estimates place the population at 150,000.

GEOLOGY AND PALÆONTOLOGY.

THE LONG-SPINED THEROMORPHA OF THE PERMIAN EPOCH.—I have at various times described the extraordinary development of neural spines of the dorsal vertebræ in the genus Dimetrodon, which belongs to the Clepsydropidæ, one of the carnivorous families of the saurian order Theromorpha. The dentition of these animals is of the most formidable character, consisting of compressed, finely serrate teeth on the maxillary and dentary bones mingled with huge conic tusks on the middle of the maxillary,

anterior end of the dentary, and occupying the entire alveolar face of the premaxillary. The huge neural spines formed an elevated fin on the back. In a medium-sized specimen of *Dimetrodon incisivus*, where the vertebral body is 35^{mm} in length, the elevation of the spines is 900^{mm} or twenty and a half times as great. The apex of the spine in this species is slender and apparently was flexible. The utility is difficult to imagine. Unless the animal had aquatic habits and swam on its back, the crest or fin must have been in the way of active movements. Accordingly the spines are occasionally found distorted at the union of surfaces of fractures. The limbs are not long enough nor the claws acute enough to demonstrate arboreal habits, as in the existing genus Basiliscus, where a similar crest exists. A very peculiar species has been described under the name of *Naosaurus claviger* Cope. There the spines are not quite so elevated as in the *D. incisivus*, but they are more robust, and have transverse processes or branches which resemble the yardarms of a ship's mast. In a full-sized individual, the longest cross-arms, which are the lowest in position, have an expanse of 260^{mm}, or ten and a quarter inches, while the spine has about the height of 500^{mm} (19.75 inches), the body being 60^{mm} long. The animal must have presented an extraordinary appearance. Perhaps its dorsal armature resembled the branches of shrubs then, as they do now, and served to conceal them in a brushy or wooded region. Or, more probably, the yardarms were connected by membrane with the neural spine or mast, thus serving the animal as a sail with which he navigated the waters of the Permian lakes. A very singular character of the spines in all the species is that they are hollow, as in Cœlacanth fishes, and that the central cavity is not closed at the apex.

There is a well-preserved cranium of the *D. claviger*, but the muzzle is unfortunately wanting. The median line rises forward so that the convexity of the top of the muzzle is higher than the posterior parts of the skull, whose profile descends rapidly. This throws the orbit far back and gives the animal a peculiar appearance.

Naosaurus differs from Dimetrodon in the transverse processes of the neural spines of the vertebræ. There are three species, which differ as follows:

Spines of vertebræ cylindrical distally; transverse processes replaced above by tuberosities...*N. cruciger*.
Spines of vertebræ expanded and compressed above.
 Palatine teeth large, forming a pavement........................*N. microdus*.[1]
 Palatine teeth much smaller and more widely spaced............*N. claviger*.

All these species are from the Permian formation of Texas. Figures of the *N. claviger* will be published in the Transactions of the American Philosophical Society.—*E. D. Cope*.

[1]*Edaphosaurus microdus* Cope, Proceeds. Amer. Philos. Society, 1884, p. 37.

THE REPORT OF THE CONGRESS OF GEOLOGISTS.[1]—This publication includes a report of the proceedings of the congress and reports of the several committees appointed to present systems of nomenclature and cartography by the Congress of Bologna. These reports are highly interesting, and display, in an instructive manner, the points of agreement and divergence between the geologists of the different countries of Europe. The digested result will constitute, when completed, the most valuable synopsis of the subject yet written. Unforeseen circumstances prevented the completion of the reports of some of the American committees, and the United States Geological Survey was not adequately represented, although Mr. McGee did his best with the means at his disposal.

The color system adopted is, as it should be, founded on that which has long been current in all countries. The new system proposed by the U. S. Geological Survey was not adopted, but a letter from Major Powell, recommending it, was read. Some of the details for representing details, proposed by Major Powell, might, we think, be introduced with advantage. The important American formations of the Laramie and Puerco must also be represented by appropriate colors. We hope that the Congress of London will make up for these deficiencies, and add to the good work done by the Congress of Berlin whatever may be necessary from other portions of the earth.

The report is well printed and is, in all respects, what was to have been expected of the distinguished secretary of the American Committee.

FIRST APPEARANCE OF THE GRASSES.—At a meeting of the Geologists' Association, held at London, April 2d, J. Starkie Gardner discussed the points bearing on the geological period at which grasses first commenced to assume a preponderating position in vegetation. Their value and importance at the present day were first sketched, and it was remarked that they occupy under cultivation one-third of the entire area of Europe, inclusive of lakes and mountains, while, exclusive of malt and spirituous drinks distilled from them, their products to the value of nearly one hundred millions sterling are imported annually into this country alone. There are over 3000 species fitted to occupy most diverse stations and to overcome nearly every kind of competition under no matter what conditions, with the result that about ninety-five per cent of the plants growing in ordinary meadowland are grasses. The conclusion arrived at was that there was no great development of grasses until towards the close of the Eocene, no definite remains being associated with any of the older Eocene floras of temperate latitudes. A number of facts

[1] The Work of the International Congress of Geologists of Berlin and of its committees. Published by the American Committee under direction of Dr. Persifor Frazer.

were brought forward to show that grasses could by no possibility have failed to become associated with the remains of other plants in beds deposited under such conditions as those of the Eocene had they existed in any profusion then, while further to support this argument it was stated that the very similar Oligocene and Miocene beds all over Europe are crowded with them. Further, it was shown that the dentition of all the early Eocene herbivorous Mammalia was adopted for crunching fruits, snapping twigs, and grubbing of roots, rather than for browsing on such food as grass, so that the evolution of true Graminivora, as well as the specialized Carnivora that prey on them, must be post-dated to the appearance of the grass itself. The geological history of the whole class of insects was reviewed, with the object of supporting the conclusion arrived at as to the *post* mid-Eocene date of grass. Older remains of grass may, however, occur in the last series of Tertiary deposits in Spitzbergen, but as yet their age has not been accurately correlated. Finally, it was shown that the introduction of an aggressive type in vast numbers and of different habits to pre-existing vegetation, exerted an influence on terrestrial life altogether without parallel, and for the first time rendered possible the development of a meadow and prairie vegetation as distinct from that of marsh, scrub and forest, with all the attendant forms of animal and vegetable life to which such vegetation is indispensable.

GEOLOGICAL NEWS.—*General.*—An orographical and geological map of Turkestan, the work of M. Mouchketoff, has been presented to the Académie des Sciences de Paris, accompanied by a geological description of the Aralo-Caspian steppes.

Carboniferous.—M. B. Renault affirms that the reproductive bodies of Calamodendrons are grains of pollen, which occur in groups of four within four sacs carried by the fertile bracts of the fruit, which recalls that of Annularia. These plants must, therefore, according to M. Renault, be regarded as gymnospermous phanerogams.

Secondary.—R. F. Tomes (*Geol. Mag.*, March, 1886) describes two species of Madreporaria of the genera Thecocyathus and Trococyathus, from the Upper Lias of Gloucestershire.

Tertiary. — R. Lydekker has described the palatal half of the cranium of a large Erinaceus from the Upper Miocene of Œningen. It is closely allied to *E. europæus*, but the describer names it *œningensis.*——The same palæontologist has described the anterior portion of the cranial rostrum of *Melitosaurus champsoides*, a crocodilian from the Miocene of Malta.——Alfred Bell reviews the succession of the later tertiaries in Great Britain in the *Geological Magazine* for February, 1886. He concludes that Britain was never otherwise than continental from the close of the Middle Red Crag to that of the minor glaciation, also that man came into Britain after the glacial epoch.

Quaternary.—According to Prof. J. N. Woldrich, seven or eight forms of domestic dogs have existed in Europe from alluvial times until now, while four species of diluvial dogs are known. Existing European dogs are therefore not descended from any species of Canidæ now living in Europe, though they may have been crossed with the wolf, fox, or jackal. The so-called feral dogs of Syria may be the remnant of a diluvial true wild dog, the greyhound is said to be certainly descended from a diluvial ancestor of the African *Canis simensis*, and long-eared small dogs may be descended from a diluvial ancestor of the fennec.——Sir R. Owen has described the premaxillary and scalpriform teeth of a large extinct wombat (*Phascolomys curvirostris* Ow.) from the Wellington bone caves. The animal must have been somewhat smaller than the type of the sub-genus Phascolomys.

MINERALOGY AND PETROGRAPHY.[1]

PETROGRAPHICAL NEWS.—In a "Preliminary paper on an investigation of the Archæan formations of the Northwestern States,"[2] Professor R. D. Irving mentions the results he has reached in the study of the Archæan formations in the region extending from Lake Huron to Southeastern Dakota. These results, as well as those reached by other investigators, have been incorporated in a map which presents in good form the present views held by the author in regard to the distribution of the rocks of this region. The map is accompanied by a report of the work which has already been done in the various districts and a description of the plans to be followed in the solution of problems which are presented in such great number. These problems are all of the very highest importance to a knowledge of the relations which the older formations bear to each other, and to the explanation of the origin of the crystalline schists. The subject of metamorphism in the Huronian rocks is referred to, and a promise is made that before long some publications in this direction may be expected. A microscopical examination of hornblende rocks, occurring throughout the region, seems to point to the conclusions (1) that many of the non-schistose varieties are really changed augitic eruptives; (2) that some of the hornblende schists were originally also augitic eruptives, while others grade into and are associated with the hornblende gneisses. In these the hornblende appears always to be of a secondary nature, every phase being found between schists in which augite excludes the hornblende to others in which the hornblende excludes augite. (3) The so-called actinolite schists are sometimes only the result of extreme alteration of eruptive green stones. The fact of the

[1] Edited by W. S. BAYLEY, Johns Hopkins University, Baltimore, Md.

[2] Fifth annual report of the Director of the U. S. Geol. Survey. Washington: Government Printing Office, 1885.

secondary origin[1] of brown basaltic hornblende is emphasized. The proof relied upon for this belief is, (1) the intimate relation of the two minerals; (2) the occurrence in the hornblende of cores of augite, several of which polarize together; (3) the occurrence of every phase of change from complete augite to complete hornblende, and (4) the nearly invariable coincidence of the occurrence of the secondary hornblende with other indications of alteration.——In a "Note on the microscopic structure of some rocks from the neighborhood of Assouan," collected by Sir J. W. Dawson,[2] Professor Bonney describes[3] gneisses, granites, hornblende schist, quartziferous kersantite and a "schistose rock, not of a highly metamorphic aspect," which "has been made out of a diorite or a hornblende schist." In some of the gneisses structures were observed which the author thinks are characteristic of the older rocks of this nature and very similar to a quartz or a gneiss from the Greenville series, occurring near Papineauville station on the Ottawa river.——Messrs. Michel Lévy and J. Bergeron[4] have recently been at work on the eruptive rocks of the Ronda mountains in the southern part of Spain. They consist principally of norites, lherzolites, tourmaline, granite and diorites. Like MacPherson before them, Lévy and Bergeron think that the serpentines have been derived by the decomposition of lherzolites. This latter rock, by the assumption of anorthite, frequently passes over into norite. The constituents of this are spinel, twins of zonal olivine, twinned anorthite, chromiferous pyroxene in twinning relation with large bands of eustatite and a little black secondary mica. Bronzite often occurs in large crystals, giving the rock the appearance of a porphyrite. Ophitic rocks from the same region are composed of titanic iron, labradorite and pyroxene, with a little olivine in the most basic varieties. The most interesting fact in connection with these rocks is the occurrence in them of a secondary glaucophane with the usual pleochroism. The most ancient schistose[5] rocks are the cordierite gneisses and amphibolites. In a mass of dolomite, intercalated in the gneiss, the following minerals were found in the order of their crystallization: pyrite, ilmenite, sphene, rutile, pargasite, humite, clino-humite, pleonast, anorthite and talc. Following the schistose rocks in age, occur eclogites and crystalline limestone containing metamorphic minerals, among which are epidote, sphene, rutile and scapolite.

[1] Cf. AMERICAN NATURALIST. December, 1885, p. 1215, and G. H. Williams, *Amer. Jour. Sci.*, October, 1884, p. 259.

[2] The *Geological Magazine*, March, 1886, p. 103.

[3] Ib., October, 1884, p. 440.

[4] Comptes Rendus, Mars 15, 1886, p. 640.

[5] Ib., Mars 22, 1886, p. 709.

MINERALOGICAL NEWS.—A. Lacroix[1] has an article in the "Comptes Rendus" on the optical properties of some minerals which are without crystal forms. In it he affirms the discovery by Des Cloizeaux that grünerite is an amphibole and not, as is generally held, a pyroxene. Its cleavage planes make an angle of 124° with each other. The plane of the optical axes is $\infty P \grave{\infty}$ and the bisectrix is negative and inclined 15° to the normal to the orthopinacoid. Pleochroism is feeble and twins are abundant. Warwickite is a borotitanate of iron and magnesium. Its crystal system is not positively known. A microscopical examination makes it appear orthorhombic, with a pleochroism in three shades of brown. The plane of the optical axes is $\infty P \bar{\infty}$, the bisectrix being positive and normal to this, which is the direction of easy cleavage. Withamite, xantholite, scoulerite and chalilite are identified respectively with piedmontite, staurolite and thomsonite, of which the latter two are but impure varieties.——Some interesting manganese minerals are described by Weibull[2] from the Wester-Silfberg mine in Dale Karlien, Sweden. A manganese magnetite gave on analysis 6.27 per cent of MnO. It is uncrystallized and is associated with masses and grains of manganocalcite. The massive variety contains 6.98 per cent of MnO and the granular mineral 24.32–24.89 per cent. A careful examination of Igelströmite[3] ($2Fe_2(Mg)\ SiO_4+Mn_2(Mg)\ SiO_4$) proves it to be orthorhombic, with the optical axes in the plane of the base and the *a* axis the negative bisectrix. Pleochroism: $\mathfrak{b}$ = grayish-yellow, $\mathfrak{a}$ = grayish-yellow-white, $\mathfrak{a}$ = yellowish-gray. Absorption, $\mathfrak{a} > \mathfrak{b} > \mathfrak{c}$. Silfbergite, first described by Weibull[4] in 1883, is further investigated. Its crystals are bounded only by the planes ∞P and $\infty P \grave{\infty}$, parallel to which the cleavages run. In polarized light these crystals are seen to be composed of twinned lamellæ with the orthopinacoid the twinning plane. The plane of the optical axes is the plane of symmetry, and the double refraction is negative. The pleochroism is marked, $\mathfrak{c}$ = dirty brown, $\mathfrak{b}$ = brownish-yellow with a green tinge, $\mathfrak{a}$ = yellow white. Absorption, $\mathfrak{c} > \mathfrak{b} > \mathfrak{a}$. An analysis of a pure variety gave:

SiO_2	FeO	MnO	MgO	CaO	Al_2O_3	H_2O
49.50	30.69	8.24	8.10	2.02	.69	.40

In the same article the author reports the result of a re-examination of the Knebelite of Dannemora. This mineral occurs in columnar masses of black to blackish-gray individuals, with three cleavages, one parallel to the faces of a prism of 50° 6′, very perfect, and the other two parallel to the brachy and macro-pinacoids. A parting perpendicular to the three cleavages was also

[1] Comptes Rendus, CII, Mars 15, 1886, p. 643.
[2] Mineralogische und Petrographische Mittheilungen, VII, 1885, p. 108.
[3] Cf. Zeitschrift f. Kryst., VIII, p. 647.
[4] Geol. Fören. Förhandl, VI, p. 504.

observed. The relation of the horizontal axes is 0.467:1. The axial plane is the base, with the *a* axis the negative bisectrix. The pleochroism is strong, $\mathfrak{a} + \mathfrak{b}$ yellowish-gray, $\mathfrak{c}$ = grayish-white. $\mathfrak{a} > \mathfrak{b} > \mathfrak{c}$. The analysis of Knebelite would indicate that it is a manganese olivine, with most of the optical properties of this mineral.

BOTANY.[1]

VARIATIONS OF TRADESCANTIA VIRGINICA.—An interesting case of floral variation is under observation by the writer in the shape of a highly aberrant form of *Tradescantia virginica*, or spiderwort, also called, in quaint allusion to the ephemeral nature of its petals, "widow's tears." Said plant presents, as the result of thirteen years' cultivation, the curious aspect of a monocotyledonous plant having in bloom, at the same time, flowers of dimerous, trimerous, tetramerous, pentamerous, hexamerous and heptamerous types respectively, each flower having twice as many stamens as sepals, petals or carpels of ovary. The plant was set out in 1872 and received very rich treatment, so that it gave forth blossoms measuring two inches in diameter. In 1874 it began to deviate from the original trimerous type and to assume the tetramerous one, by developing another petal, and instead of doing this at the expense of the pistil or stamens, it *added* another sepal, another carpel with style, and two stamens, thus making a typical tetramerous flower. The plant has since then continued to differentiate in a greater degree each succeeding year, the differentiated forms being typical plants and maturing seed capable of perpetuating and possibly increasing the differentiation. The seed of differentiated forms gives plants having a large number of aberrant forms, while that of normal flowers gives a few abnormal forms, showing that the plant is working out a plan of evolution. The original trimerous plant was set out in 1872; in 1874 the tetramerous plant was evolved; in 1876 the pentamerous; in 1879 the hexamerous; in 1882 the dimerous; and in 1884 the heptamerous. Of these differentiated forms, as observed last year, the most plentiful were the *pentamerous* flowers, giving a complete refutation to the dictum, "Endogens *never* have the parts of the flowers in *fives*."

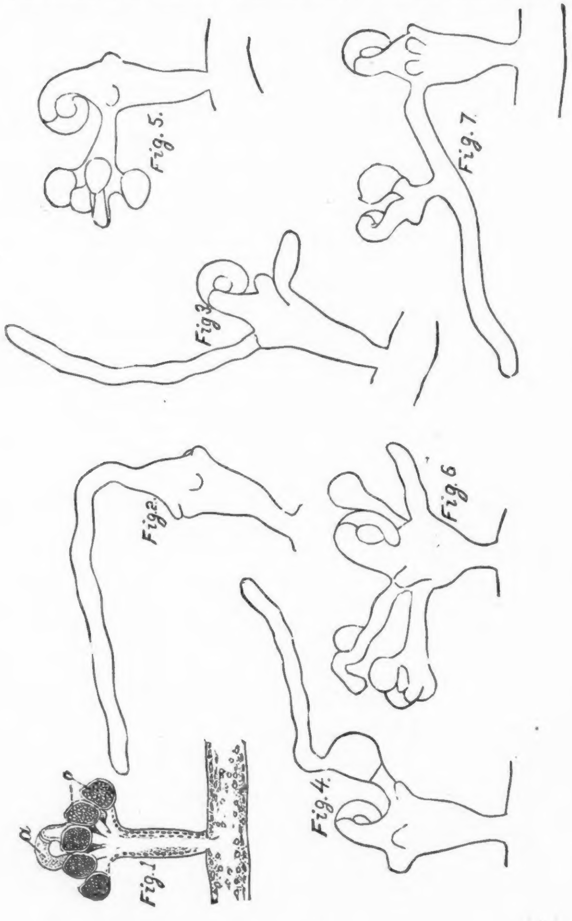
The dimerous and heptamerous types are as yet but few, as they are struggling for existence. The hexamerous and heptamerous flowers occasionally show an imperfect carpel, and in one case a heptamerous flower had an octamerous ovary with two imperfect carpels, showing that seven is evidently not the limit of differentiation. A number of interesting experiments have been made regarding the intensity of variation, showing that it is very pronounced.

Roots of this plant and seeds from trimerous, tetramerous,

[1] Edited by Professor CHARLES E. BESSEY, Lincoln, Nebraska.

hexamerous and pentamerous forms have been sent to Dr. Asa Gray for cultivation, at his request.—*G. A. Brennan, Roseland, Ill.*

Some abnormal Forms of Vaucheria.—While engaged in the study of Vaucheria with my classes in botany, some weeks since, my attention was called to some very curious abnormal develop-



Abnormal forms of Vaucheria.

ments that seemed to me worthy of record. The commonest species of Vaucheria in the neighborhood of Detroit is *V. geminata* Vauch, var. *racemosa*, and it was in this species that the abnormal growths referred to were observed.

The ordinary form of the fertile part of the plant is shown in Fig. 1. The sexual organs arise as buds upon a common branch, the single antheridium being terminal and decidedly curved; the oögonia varying in number from two in the typical form of the species to eight or nine in some specimens of the variety. They are arranged in a circle about the base of the antheridium (Fig. 1, *o*).

The specimens when first collected showed no peculiarities, but after being kept for a week or two in rather confined quarters, a large proportion of the fertile branches developed abnormally, owing no doubt to the unnatural conditions in which the plants were grown.

The accompanying figures will show the more peculiar cases observed. In all of these it will be seen that the branches that under ordinary circumstances would develop into the sexual organs are here variously modified.

In Fig. 2 the antheridium is replaced by a filament that is in all respects like an ordinary vegetative filament.

In Fig. 3 the antheridium is perfect, but the oögonia are replaced by slender filaments.

In Fig. 4 one oögonium has developed, but its apex is prolonged into a filament like those in Fig. 3.

In Fig. 5 the antheridium is complete, but one of the lateral buds has developed a secondary branch bearing a complete set of sexual organs, a perfect antheridium and four perfect oögonia.

Fig. 6 shows a case where in addition to the ordinary antheridium two others are developed with accompanying oögonia from the lateral buds.

In Fig. 7 one of the lateral buds has grown out into a filament which bears laterally a smaller branch upon which a perfect antheridium and oögonium and a rudiment of a second oögonium were formed.—*Douglas H. Campbell, Detroit, April, 1886.*

Botany in Winter.—In connection with the subject of "Teaching botany in winter," treated recently, though briefly, in the American Naturalist, I would like to say a few words. My sophomore class of over fifty members begins its second term in botany the last week in February. The college vacation is during December, January and most of February. The sophomore class has had one term of botany as freshmen in the previous autumn. The class meets twice each week in both the freshmen and sophomore years, and a field exercise is required between each meeting. During the autumn the class study first leaves, next flowers and later in the season fruits. Any botanist will at once note the special facilities for the study of fruits. The class comes to the sophomore work in February, having had very little concerning stems and buds. The first field exercise for this year was the making of a careful drawing of at least three inches of

the tip of an elm and of a maple branch. The students were given no further instruction. They are never told what to look for. From my pile of sketches and descriptions I quote the whole of the first one without making any selection:

"1. Drawing of maple branch with terminal and opposite lateral buds. Stem thick and of a red color, covered with small specks. Wood not so tough as elm. Buds more tender. 2. Drawing of elm twig with a terminal bud and alternate lateral buds. Wood compact and tough. Buds appear to be better protected from weather than maple." The drawing, if not the description, would indicate that the maple is *Acer dasycarpum.*

For the next field work each member of the class was requested to make a study of the last year's growth of a branch of each of two kinds of Acer. What is Acer? was one of the first questions each member answered for himself. This lesson brought out the specific peculiarities of members of the same genus—peculiarities not easily found in books within the reach of students. One of the first duties of a teacher in natural science is to keep students away from printed descriptions. They must go to the objects and make their own descriptions. I quote again from the first paper:

"The bark of No. 1 is of a lightish color and it is difficult to tell a year's growth, while that of No. 2 is of a red color and it is very easy to recognize a year's growth, as there is a marked difference in the color. The coverings of the buds of No. 1 are much more scaly than those of No. 2, and they are also more closely attached to their buds than those of No. 2 are attached to their buds. The internodes of the first are much shorter than those of the second. The year's growth of the first is shorter than that of the second, as it grows more slowly."

Much better work than this is found on several papers. The "chance selection" is not far below the average. The following questions were given the class at its next meeting and written answers handed in: (1) Have you observed any branching on the last year's growth? (2) What are the differences in the buds of the two maples? (3) Give number of buds on year's growth of each. (4) Relative size, flexibility and strength of the two kinds of twigs. (5) Where are the flower-buds? The fourth question opened the eyes to many important subjects, and the fifth set them in search of the promises of blossoms on the twigs. At this meeting two microscopes were so placed that each student of the large class could look in as he filed out of the lecture-room at the close of the exercise. Under the first instrument was shown a longitudinal section of a fresh leaf-bud, and under the second a like view of a flower-bud, both of the lilac. It may be stated here, in passing, that each member of the class gets either one or two microscopic views in the above way at each meeting.

Without here fully following out the course, it may be said that

after the buds and branches had been canvassed we took up the evergreens, and as a first lesson each student made a drawing of a branch of any pine and any spruce he might choose. This was followed by a study of two species of Pinus, which brought out the characteristics that pertain principally to branches and their leaves. The study of the evergreens being disposed of, in of course only a general way, the class took as a single field exercise the following: Make a study of a branch bearing thorns and of another bearing prickles.

It would be a pleasure to reproduce here the descriptions on a dozen papers, but already these notes are far longer than they were expected to be at the outset. Here is one, however:

"No. 1 has large spines or thorns situated just above the lateral buds. These thorns are branched, having small thorns very much like the original one, only smaller. One of these thorns has two small ones upon it situated nearly opposite each other. No. 2 has many prickles, with three on each internode. They appear to have a definite arrangement with respect to each bud, one being situated a little to the left of and below the bud, another is a little farther down on the stem and to the right; the third is much farther down and directly under the bud. The prickles are quite large at the base, but easily broken off from the bark. Many of them have fallen off. Prickles grow on the bark and have no union with the wood, and come off on the bark when the branch is peeled. The thorns are connected with the woody structure."

To-day (March 28th) the class brought in their work upon the study of pith. The directions given were as follows: Study the stem of a plant with a large pith and one with a small pith. The two stems are to be of the same diameter. Make a cross-section of each stem and draw them four times enlarged, showing all the parts. Make radial section lengthwise and draw as for cross-section.

Each student collects his own material. A specimen paper, of course without the drawings, is submitted:

"The linden (No. 1) has a small pith about $\frac{1}{32}$ inch in diameter, situated at or near the center. The relative thickness of wood to pith, in No. 1, is about one to seventeen, and in No. 2 (elder) it is about three to five. The distance from the surface of the bark to the pith, in No. 1, is about $\frac{5}{16}$ inch, the stem being a little more than $\frac{5}{8}$ inch in diameter. In No. 2 the distance from the surface of the bark to the pith is nearly $\frac{3}{16}$ inch, the diameter being about the same as that of No. 2. The pith in the latter is not so firm as that of No. 1, and seems to be made up of larger cells. The middle layer of bark in No. 1 is of a greenish color, that of No. 2 has brown spots which seem to alternate with spots of white. These spots are mostly triangular in form, with the base next to the wood."

Work of the nature above pointed out will be continued until

the spring flowers come, when each student is prepared to make an herbarium of plants collected and determined by himself. It is doubtless true that the work in the fall term helps in the field work herein mentioned, but there is no question that students with no knowledge of plants can take hold of botany in the winter and do excellent, interesting work—work that is at the foundation of morphology and gross anatomy, the fresh material for which is in better condition than during the growing season when buds are forming and branches and leaves obscure the view.—*Byron D. Halsted.*

ENTOMOLOGY.

A CARNIVOROUS BUTTERFLY LARVA—PLANT-LICE FEEDING HABIT OF FENESICA TARQUINIUS.[1]—One of the most interesting of our butterflies is that known as *Fenesica tarquinius*, a unique Lycænid having the wings above brown-black in color with conspicuous orange markings both on primaries and secondaries. It has a wide geographical range, occurring very generally over North America as also in Asia.

Donovan, in his "Insects of India" (Pl. XLIV, fig. 1), illustrates the butterfly rather poorly, but says nothing about the larva.

Boisduval and LeConte (Hist. des Lép. et des Chen. de l'Am. Sept., p. 128, Pl. XXXVII) figure the larva, pupa and imago under the name of *Polyommatus cratægi*, and simply quote Abbot as stating that the larva lives on several species of Cratægus.

Scudder (Proc. Essex Inst., Vol. III, p. 163, 1862) treats of it under the name of *Polyommatus porsenna* (Syn. List of Am. Rurales, Bull. Buff. Soc. Nat. Hist., III, p. 129, May, 1876) and gives the food-plants of the larva as Alnus, Ribesia, Vaccinium and Viburnum. Later, in the AMERICAN NATURALIST for August, 1869, he gives the food-plants as follows: "Probably arrow-wood, elder and hawthorn."

Grote (Trans. Am. Ent. Soc., II, p. 307) first proposed the generic name of Fenesica, but says nothing about its larval history.

Strecker (Butt. and Moths, etc., Diurnes, p. 103) repeats simply from Scudder; while Wm. H. Edwards, in his admirable life-histories of butterflies, has not so far treated of this particular species. In short, so far as the published records go, it has been generally assumed that the larva feeds upon the plants named.

The object of this brief communication is to show that in this larva we have one that is truly carnivorous, a fact which is extremely interesting because, so far as I can find, there is not another recorded carnivorous butterfly larva; and Mr. Scudder, who has given great attention to the butterflies, writes me in a recent letter, in reply to an inquiry on this point, that he cannot recall any mention of such. Quite a number of Heterocerous larvæ

[1] Abstract of a paper by C. V. Riley, read Feb. 20, 1886, before the Biological Society of Washington.

are known to be carnivorous by exception, and not a few are so as a rule. These are chiefly found among Pyralids, and it is not necessary for my present purpose to refer to the cases in detail.

For some years now I have been studying the remarkable life-habits of the Aphididæ and especially of some of the gall-making and leaf-curling species of Pemphiginæ.

In the collecting of material and making of observations, I have been assisted by Mr. Th. Pergande, who has on a number of occasions, since 1880, found the larva of this Fenesica associated with various plant-lice. Among the species with which it has been thus found associated are *Pemphigus fraxinifolii* Riley, which curls the leaves of Fraxinus; *Schizoneura tessellata* Fitch, which crowds upon the branches of Alnus; and *Pemphigus imbricator* Fitch, which congregates in large masses on Fagus. All these species produce much flocculent and saccharine matter.

The frequency with which this larva was found among these plant-lice justified the suspicion that it feeds upon them or derives benefit from them; yet up to 1885 the presumption was that it benefited from the secretions of the plant-lice rather than from the insects themselves. Last fall, however, Mr. Pergande obtained abundant evidence that the Fenesica larva actually feeds upon the Aphidids, and I thought it worth while to call attention to this positive proof of the carnivorous habits of the species. That the different species of plant-lice are the normal food of this larva is rendered more than probable for the following reasons:

1. Attempts to feed the larva upon the leaves upon which it was found have proved futile, the larva perishing rather than feed upon them.

2. The food-plants given by the authorities are such as are well known to harbor plant-lice.

3. Mr. Scudder's authorities, as he informs me, were picked up here and there and one of them for alder, which he recalls, viz., a Mr. Emery "found it more commonly on a limb among plant-lice."

4. Mr. Otto Lugger has frequently observed the larva around Baltimore, among *Pemphigus imbricator* on beech, but never dis-associated from the lice, and Judge Lawrence Johnson also found it in connection with the same species around Shreveport, La., last fall and surmised that it might feed upon the Pemphigus, but neither of these observers were able to get positive proof of the fact.—*C. V. Riley.*

WITLACZIL ON COCCIDÆ.—Dr. E. Witlaczil completes his notes on the plant-lice by an interesting article on the Morphology and anatomy of the Coccidæ, in *Zeitschr. f. Wissen. Zoologie*, Vol. XLIII, pp. 149–174. At first both the male and the female larvæ possess limbs, antennæ and simple eyes, which are subsequently lost by both sexes, the females degenerating so as to become wax-covered,

immovable forms, and the males acquiring an improved edition of all these organs, with wings superadded. The antennæ and wings of the males arise as evaginations from invaginal disks, are afterwards withdrawn during the quiescent or pupal stage, to be finally driven out again on reaching maturity. Contrary to the usual way in Hemiptera, these males undergo complete metamorphosis. The waxy coat of the female consists not of the larval cuticles that were shed, but of variously crumpled and felted wax filaments emitted by dermal glands, and enclosing the remains of the cuticles. The embryological development is much as in Aphides, but the eggs have no pseudo-vitellus.

Some notes on the Chermetidæ are appended to the article, especially on *Chermes abietis* and on Phylloxera. He kept the galls of Chermes, in autumn, till the parthenogenetic females escaped, of two varieties, some yellow, others nearly black. The female oviposited on the needles of a pine-branch in a heap. After this operation the mother died, protecting the eggs with her shrunk body and wings. In spring large wingless females were found on the pine-shoots, having remained over winter. Each had thirty to forty egg tubules, with two to four well-formed eggs; and the eggs had a pseudo-vitellus. The eggs were laid in masses at the base of the young pine-shoots; the masses of eggs being covered with wax and with the carcass of the mother. The young issuing from these eggs moved to the axils of the needles, and together formed the nucleus of a cone-like gall; by their sucking the needle swells, coalescing with the gall. It is not the swelling of the needle, but of the branch that causes the gall; and this is due to the piercing action of the larvæ, not of the mother.—*G. Macloskie.*

The Origin of the Spiral Thread in Tracheæ.—A Correction.—Since the article on this subject was published in the May Naturalist, I have examined more specimens of insect tracheæ, in which the "spiral thread" seems to be present; but I do not think the tænidia invariably form a continuous spiral thread. In the axils of the branches we see short spindle-shaped tænidia; and each branch has a separate "spiral thread." In certain fine tracheæ of the eyes of the fly no spiral threads are developed, judging by Hickson's researches. Where the thread is continuous it may be called a *tænidium;* when only separate rings are developed they may be called *tænidia.* I think, however, that I have demonstrated the nuclear origin of the "spiral thread," and that the elongated filamental nuclei of the endotrachea coalesce to form the spiral *tænidium.*—*A. S. Packard.*

Destructive Locusts in Texas.—During the past winter the eggs of some species of locusts were reported by Mr. R. T. Flewellen, of Houston, Texas, to occur in great numbers in Washington county, and fears were expressed of great injury, this season, from the resulting locusts. Professor Riley, of the Depart-

ment of Agriculture, has had the matter investigated and it appears that the young locusts, which are now all hatched, turn out to be one of the larger wide-spread species, viz., the differential locust (*Caloptenus differentialis*). This species has at times been very abundant in Illinois and in other States but, according to its past history, there is no danger of its ever becoming so serious a pest as the Rocky Mountain locust, and hence Professor Riley believes there is no occasion for alarm.

Entomological News.—At a recent meeting of the London Entomological Society, the venerable Professor Westwood remarked that an insect (*Machærota ensifera* Burm) in Ceylon, allied to the frog-hopper (Aphrophora), instead of being enclosed in a liquid (cuckoo-spittle), formed a case by the rapid hardening of the liquid secreted.——Dr. Geo. Marx, artist of the Agricultural Department, publishes in *Entomologia Americana* for May, a description of the male of *Gasteracantha rufospinosa* from Florida, with excellent figures of the two sexes. Although 170 species of this genius are known, the males of only two species have been hitherto discovered. The male differs much in shape, besides being less than one-quarter as large as the female.——In Bulletin No. 5 of the Cal. Acad. Sciences, T. L. Casey revises the California species of Lithocharis and allied genera of Staphylinidæ.——The Transactions of the American Entomological Society, XII, Nos. 3, 4, complete an excellent volume. They contain a thorough monograph of North American Chrysididæ, by S. Frank Aaron, illustrated by five plates; a monograph of the earlier stages of the Odonata, subfamilies Gomphina and Cordulegastrina, by Dr. H. A. Hagen; and a useful bibliographical and synonymical catalogue of the North American Cynipidæ, by Mr. W. H. Ashmead, with description of new species. Appended is a list of species peculiar to designated trees and plants, the greater number, as is well known, living on the oaks.

ZOOLOGY.

Self-Division in Septic Monads.—In Dr. Dallinger's annual address before the Royal Microscopical Society, Feb. 10, he detailed the results, which are published in full in the journal of the society for April. Four forms were selected for study. In each of the four organisms the facts were discoverable in the development of the nucleus, the origin of the flagella and the growth of the body. They were best seen in *Tetramitus rostratus* and *Polytoma uvella;* not quite so well in *Dallingeria drysdali*, and least perfectly in *Heteromita rostrata;* but in all they were seen with sufficient clearness to leave no doubt. Each of these septic organisms terminates a long series of fissions with what is practically a generative act of fusion. The last two of a long chain of self-divided forms fuse into one, become quite still, and at length

the investing sac bursts and a countless host of germs is poured forth. The growth of these germs into forms like the parent was continuously watched, showing gradual enlargement and ultimate, but as to time somewhat uncertain, appearance of the nucleus, and the somewhat sudden appearance of the flagella or thread-like motor organs, the latter being found in each instance to arise in the nucleus. Very soon after the adult stage is reached the act of self-division commences, and is kept up for hours in succession. The delicate plexus-like structure becomes aggregated at one end of the nucleus, leaving the rest perfectly clear, except that a faint beading is seen in the middle line, with two or three fine threads from it to the plexus. Then occurs the commencement of partition of the nucleus, followed by a slight indication of division of the body-substance. Quickly afterwards the nucleus becomes completely cleft, and the body-substance follows suit. Then the plexus-like condition is again diffused equally over the whole nucleus. When the generative condition is approached by the last generation of a long series of dividing forms, it is remarkable that the organism becomes amœboid, showing how far-reaching is the amœboid state. In this condition, when two such forms touch one another, they coalesce and fuse into each other almost as though two globules of mercury had touched, until nucleus reaches nucleus and two melt into one, and the blended bodies become a globular sac, which ultimately emits an enormous number of germs. Previous to the blending it is now made out that all traces of plexus-like structure are lost in the nucleus, which becomes greatly enlarged and assumes a milky aspect, and shows no trace of structure throughout the process of fusion. Afterwards it begins to diffuse itself radially through the body-sarcode until every trace of the nucleus is gone, and the still globule of living matter becomes tight and glossy, but no trace of structure can be anywhere found in it. In this condition it remains for six hours, when it emits the multitude of germs. After giving similar details about several other organisms, Dr. Dallinger summed up thus: "One thing appears clear, the nucleus is the center of all the higher activities in these organisms. The germ itself appears to be but an undeveloped nucleus, and when that nucleus has attained its full dimensions there is a pause in growth, in order that its internal development may be accomplished. It becomes practically indisputable that the body-sarcode is, so to speak, a secretion, a vital product of the nucleus. From it the flagella originally arise; by it the act of fission is initiated and in all probability carried to the end; the same is the case with fertilization and the production of germs. We are thus brought into close relation with the behavior of the nucleus in the simplest condition. No doubt far profounder and subtler changes are concurrently proceeding. We, of course, are no nearer to the solution of what life is. But to come any distance

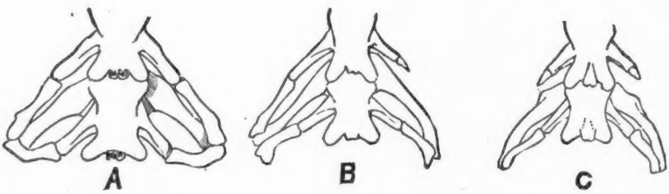
nearer to a knowledge of how the most living part of the minutest organisms acts in detail has for me, and for most biologists, an increasing fascination."

Blue Color of Animals.—Professor F. Leydig says that a blue granular pigment is rarely found in animals; in the crayfish, for example, there are blue crystals. The blue color is more often due to interference, owing to the presence of lamellæ, or to the fibrils of connective tissue, as in the tapetum fibrosum of the eye of ruminants; the corium of the living larva of *Pelobates fuscus* is similarly blue. A dull material overlying black pigment produces blue, as in the case of blue eyes, which are due to the urea shining through the non-pigmented iris, and in some frogs. Dark chromatophores have a like effect, as has too the swelling of the corium consequent on the filling of the lymph-spaces. In conclusion, the author discusses the tegumentary secretions, which are of various colors, and which can be washed away; an example is to be seen in the celestial blue color of the abdomen of *Libellula depressa* and, perhaps, the "bloom" of the pupa of the Apollo butterfly. On the other hand, the coloring matter may be in cells of the epidermis, as is the case with the rosy color of *Tetrao urogallus*, and can then, of course, only be removed after the destruction of the tissue which contains it.—*Journ. Roy. Micr. Soc., April, 1886.*

Perception of Brightness and Color by Marine Animals.—Professor V. Graber has made some further experiments on marine animals with the divided box already used by him. He finds that the common star-fish is an eminently leucophilous or light-loving animal, for the bright division of the box always contained 2.2 as many individuals as the dark; they avoid red, or are erythophobes, three times as many seeking a dark-blue compartment. The common jelly-fish (*Medusa aurita*) was neither specially sensitive to brightness nor to color; but it is possible that the results might be different with larger aquaria. *Idotea tricuspidata* is very sensitive to light at the maximum differences in brightness, for 6.3 as many individuals sought the white as the dark compartment; but they are quite insensitive to less marked differences. They object to red and like blue. *Gammarus locusta* does not seem to be affected by light or shade. *Rissoa octona* dislikes the dark and is sensitive to less marked distinctions; it again, in the proportion of 103 to 2, liked blue and avoided red. *Gasterosteus spinachia*, like fresh-water fishes, prefers darkness in the proportion of 78 to 6, and *Syngnathus acus* gave somewhat similar results.—*Journ. Roy. Micr. Soc., April, 1886.*

The Sacrum of Menopoma.—In a recent paper read before the Biological Society of Washington, Mr. F. A. Lucas drew attention to the fact that the figure of the pelvis of Menopoma in the article Amphibia, ninth edition of the Encyclopædia Britannica,

must have been drawn from an abnormal specimen. The figure and accompanying text credit Menopoma with two sacral vertebræ, but an examination of ten specimens failed to show the occurrence of more than one. An abnormal specimen in the possession of Professor H. A. Ward showed an intermediate condition between the figure in the Enc. Brit. and the normal sacrum, having the right ilium attached to one vertebra, and the left to two vertebræ. Mr. Lucas further called attention to the variation in the number of dorsal vertebræ in certain Urodeles. Menopoma may have 19 or 20 pre-sacrals; Necturus, 18 or 19. Siren may have 41, 42 or 43 pre-caudals; Muraenopsis, 64 or 65. The total number of vertebræ in two perfect skeletons of Siren was 101 and 108; in three perfect Muraenopsis, 105, 107, 111.



A, specimen with two sacral vertebræ, fig. 2, article Amphibia, Encyclopædia Britannica, 9th ed.; *B*, specimen normal on right side, two sacrals on left—drawn by H. L. Ward from a skeleton in the possession of H. A. Ward; *C*, normal specimen.

Zoological News.—*Vermes.*—M. J. Perrier announces as the result of his studies of the Trematoda (Archives de Zool. Experimentale, 1885) that the muscles divide at their extremities, the divisions being inserted upon projections of the inner side of the cuticle. The suckers have a more developed muscular system than has hitherto been admitted; since they are completely enveloped by one or two elastic membranes upon which the muscular bundles of the organ are fixed and are also subject to the action of exterior muscles. There is often a mass of glandular cells in the external layer of the parenchyma. The digestive tract is always covered internally by a layer of elongated cellules united only at their base. The canal of Laurer is not a vagina, but a canal of safety, permitting of the discharge of any too abundant genital products. From the disposition of the external orifices external self-fecundation is the only mode of fecundation possible. The spongy cords found in all Platyelminths are certainly nerve fibers, and the large multipolar cells are nerve cells.——Dr. von Linstow describes (Arch. f. Natur., 1885, part III) several new Nematodes and Trematodes.

Echinoderms.—M. Ed. Perrier contributes to the Annales des Sciences Naturelles an account of the echinoderms collected by

the *Travailleur* and *Talisman.* These include several Brisingidæ and Stichasteridæ; species of Cribrella and Solaster; several Pterasteridæ, a family almost entirely confined to great depths; many Goniasteridæ, and some Archasteridæ and Porcellanasteridæ. Asteriadæ and Asterinidæ are almost wanting, Linckiadæ entirely so. Sixty-four species is the total, of which fifty are new.

Mollusks.—The Archiv. für Naturgeschichte for 1885 (part III) contains remarks upon the post-embryonal development of the Naiadæ, by Fred Schmidt.——In a second article upon the molluscan fauna of Behring's sea (Arch. f. Naturgeschichte, 1885, part III) A. Krause enumerates sixty-six Gastropoda, including several new species and three Pteropods, one of which is new.

Mammals.—Dr. E. L. Trouessart (Ann. d. Sci. Naturelles) supports his previously-expressed views that the musk-rat of the Antilles should be placed in the genus Hesperomys, but made the type of the sub-genus Megalomys. The form of its teeth will not permit it to be ranged under the sub-genus Holochilus, which is by Mr. Thomas considered to be a genus. *Megalomys pilorides* has as yet been found only in Martinique and St. Lucia. It reaches the size of a rabbit, and did great damage to the plantations. Systematic war waged upon it by the colonists has almost, if not quite, brought about its extinction, so that the examples in the Paris Museum are perhaps all that is left of this curious and interesting species. [The name Megalomys is preoccupied.–*Ed.*]

EMBRYOLOGY.[1]

1. The Development of Patella.—Dr. William Patten,[2] of Boston, while working in Claus's laboratory at Trieste, succeeded in artificially fertilizing the ova of a species of Patella, the specific name of which is not given. The ova measured 0.12^{mm} in diameter; bluish-green in color and opaque. Acetic acid and glycerine were used to render them transparent enough for a study of the general external characters. The internal changes were studied by means of sections. The eggs were matured from the first of November to the middle of January.

The ova were covered by a very thick transparent chorion, traversed by fine pore canals. The micropyle was a wide crater-like opening in the chorion at one pole of the egg; within this opening were a number of highly refractive globules which greatly interfered with the observation of the fecundation and formation of the polar globules. Ten minutes after removing the ova from the ovaries, the pole globules appear as two colorless and transparent prolongations arising from the surface of the ovum at the bottom of the crater-like micropyle. The polar cells are of great

[1] Edited by John A. Ryder, Smithsonian Institution, Washington, D. C.

[2] The Embryology of Patella. Arbeiten aus dem Zool. Inst. zu Wien. Tom. VI, Hft. 2, pp. 149–174, pls. I to V, 1885.

size as compared with those of other types. Two polar globules arise side by side and not one beneath the other, as in other cases. As many as five distinct polar globules were extruded in abnormal cases, and the extremity of one of these was enlarged into a globular form, the same as one of the two in the case of the normally developing egg. The polar cells finally become much reduced in size and are easily detached from the egg.

The segmentation is slightly meroblastic and a hollow blastula is soon formed; hatching occurs in about ten hours, when the apical cells and the two equatorial rings of velar cells have become ciliated. At the vegetative pole of the blastula four large, so-called *endo-mesodermal* cells, forming part of the wall of the blastula, are elongated and prolonged into the blastocœl and two of them have their inner ends segmented off to form the primitive mesoderm; the other two and what remains of the two preceding ones give rise to the endoderm or intestine, while the decreasing area on the outside of the blastula embraced by the endo-mesodermal cells represents the blastopore. The primitive pair of mesoblastic cells are bilateral in position and render the larva bilaterally symmetrical. The blastoporic area gradually assumed a more ventral position and is then shoved forwards and inwards, finally disappearing at the bottom of a deep furrow which partially closes or concresces from behind forward, leaving the permanent mouth—stomodæum—at its anterior end, from which the œsophagus extends inwards toward the original site of the blastopore at the bottom of the stomodæal invagination. On either side of the posterior part of the stomodæal furrow there is a swelling; this pair of swellings eventually leads to the formation of the foot, on either side of which the otocysts are invaginated. At this stage also the shell gland is developed and the two primitive mesoblastic cells have segmented into a row of three cells each, lying symmetrically on either side of the median plane of the embryo. A glossophoral sac is formed in the floor of the œsophagus, and the anus is obviously broken through late.

The important points brought out in this paper are the following: (1) the possibility of artificially fertilizing the eggs of Gastropods; (2) the presence of a definite blastoporic area which is carried ventralwards and forwards leading to the formation of the mouth and œsophagus; (3) the presence of a pair of bilaterally disposed primitive mesoblast cells, derived from two of the endomesodermal cells, and the subsequent development from the former of a pair of mesoblastic cords on either side of the median line; (4) the partial concrescence and closure from behind forwards of the ventral furrow in which the blastopore is situated.

The oldest embryo figured is one of 130 hours. The figures are excellent, and the paper as whole bears evidence of having been prepared with great care, and represents an important contribution to molluscan embryology.

2. The Development of Dentalium.[1]—M. Kowalevsky concludes that the development of Dentalium has a good deal in common with that of the Lamellibranchs, the segmentation resembling that of Unio as described by Rabl, and Teredo as described by Hatschek. The segmentation is nearly regular, and leads to the formation of a hollow blastula and an invaginate gastrula. The mesoderm is derived from the inner wall of the invaginated side of the blastula, and the mesodermic cells are disposed symmetrically on either side of the median line. The shell-gland becomes defined very early on the dorsal aspect of the embryo, and as the blastopore travels forward, as in Patella, the area of the shell-gland, or mantle-organ, becomes greater, so that it gradually embraces the body of the embryo, especially over the region just behind the foot, leading to the development of the characteristic tubular shell. The resemblance of the larvæ of Dentalium to those of the Annelids is shown to be only a very superficial one. Three ciliary girdles encircle the anterior or cephalic pole of the larval body. The blastopore is wide at first, and persists as such much longer than in Patella; it is also elongated in the process of shifting towards the ventral, anterior aspect. A radular sac is developed on the inferior side of the œsophagus. The cephalic ganglia develop from a pair of deep invaginations of the ectoderm of the velum; the pedal ganglia from a pair of proliferations of cells from the ectoderm of the foot. The otocysts are developed before the pedal ganglia on either side of the foot and much in the same way as in Patella.

This memoir, illustrated with eight well-executed plates, the figures being drawn from actual sections, is a very important contribution to molluscan morphology, as nothing of equal value has appeared since the publication of the paper on Dentalium by H. Lacaze-Duthiers in 1857.

3. The Development of the Chitonidæ or Polyplacophora.[2]—This important paper by M. Kowalevsky discusses very fully the development of *Chiton polii*, valuable observations being also recorded upon *Ch. olivaceus* Spengler, and *Acanthochites discrepans* Brown. The ♀ carries about a mass of eggs in the mantle cavity, between the gills and mantle; those set free by the ♀ do not develop normally. The ova are enclosed by a chitinous covering, consisting of hexagonal plates which support processes externally, which vary in form in the various species.

The four first segmentation spheres are nearly equal; each of these subdivide into two, giving rise to four upper and four lower ones. The polar globules rest near the center of the area

[1]Etude sur l'Embryogenie du Dentale, memoire VII, par M. A. Kowalevsky, Ann. du Mus. d'Hist. Nat. de Marseille, Zool. Tom. I, Seconde partie, 1882–1883.

[2]Embryogenie du *Chiton polii* (Philippi) avec quelques remarques sur le Developpement des autres Chitons, memoire V, par M. A. Kowalevsky, Ann. Mus. d'Hist. Nat. de Marseille, Zool., Tom. I, second partie, 1883. 4to, pp. 46, pls. VIII.

embraced by the four upper, smaller cells of the animal pole. By division of the lower cells there arises a third layer of four intermediate cells, and soon after these four others appear which are apparently derived from the four upper ones. Thereupon six more smaller cells are developed at the animal pole, and somewhat later eight more such appear at the vegetative pole, so that the embryo is now composed of thirty-six cells. At this stage the gastrula mouth begins to develop; at first, as a slight depression, which later becomes deeper, leading to the formation of a symmetrical gastrula consisting of ecto- and endoderm. The two annuli or cycles of large cells, which represent the velum, are now differentiated.

The gastrula is next somewhat elongated, and near the blastopore an endodermal cell is pushed into the blastocœl to give rise to the mesoderm. The blastopore is soon displaced somewhat ventralwards, and simultaneously certain ectodermal cells are drawn inwards to form part of the wall of the cavity of the gastrula. There are two distinct, symmetrically disposed groups of mesodermal cells near the blastopore; the largest of these cells still form part of the endoderm and take part in limiting the cavity of the gastrula. The blastopore is gradually shoved nearer to the velum, and in connection with it is developed an œsophagus formed of ectodermal cells. The mesodermal cells have multiplied, but retained their bilaterally symmetrical position.

The œsophagus is now a spacious sac, from the posterior, inferior wall of which a radular sac has been invaginated. Immediately behind the mouth, in a median line, there is developed an invagination, which Kowalevsky calls the pedal gland. Two longitudinal, anteriorly conjoined thickenings of the ectoderm, which encroach upon the mesoderm, form the rudiments of the pedal and branchial nerves. The four nerve cords are gradually split off from the ectoderm and assume their definitive position in the mesoderm. The cavity in the pedal gland becomes filled with a slimy secretion. At the apex of the velar area a pair of ectodermal cells support a tuft of cilia. At certain points, where spiculæ appear later, each spicule-forming ectodermal cell acquires a clear vacuole. There now appear seven transverse furrows on the dorsal aspect, in each of which the cuticula, which now covers the back, becomes thickened. The ventral aspect is now mostly embraced by the foot, which consists of a layer of deep columnar ciliated cells. Anteriorly the cephalic ganglion is developed as a cellular body, enclosing a hollow cavity, and posteriorly the branchial ganglion appears as the widened ends of the two branchial nerves, lying close to the ectoderm. The posterior section of the gut is surrounded by a dense mass of mesodermal cells, which doubtless furnish the materials for the development of the segmental organs, vessels and sexual organs. At a somewhat later stage fibrils from multipolar cells are developed in the

cephalic ganglion. In the anterior part of the body, the mesodermal cells form a gelatinous connective tissue between the organs. The pedal gland is now very strongly developed; its secretion is poured out between the ectodermal cells, a special opening for it being absent. At the sides of the body, above the foot, a ciliated band is present, which marks the site where the branchiæ will appear. At the level of the first dorsal fold, the eyes may be recognized. The larva now leaves the egg envelope and swims about by means of its velum. The calcareous spicules are still enclosed by their mother cells, but soon break through. After the lapse of several hours to several days, the larvæ finally rest on the bottom, losing the velum, which is replaced by other ectodermal cells. A diverticulum of the intestine at this time probably represents the liver. An invagination at the posterior end of the body seems to be the rudiment of the rectum. The pedal gland seems to have become smaller than in the preceding stage; in young Chitons (probably a year old) it is still present, but in those somewhat larger it is absent; it is, therefore, an organ pertaining to the embryonic period. The cuticular thickenings which lie in the transverse dorsal furrows are the rudiments of the segmented shell, and in each furrow, beginning at its anterior border, small calcareous plates are formed. The eyes are heaps of pigment in the ectoderm, with a clear nucleus in the center, lying close to the branchial nerves. In a fully developed young Chiton they were sunken into the skin and the ectoderm became circumscribed somewhat in the form of a cornea. The eight segments of the shell appear sometime after the metamorphosis in *Ch. polii* and *cinereus*, but in *olivaceus* somewhat before it.

4. The Development of the Gill in Fasciolaria.[1]—Dr. Osborn's observations show that the gill of this gastropod is developed from a ridge of the ectoderm formed in the median line between the border of the advancing mantle and the velum. Later, with the growth and folding forward of the mantle and the formation of a mantle cavity, the gill is also carried forward and is brought to occupy a position on the outer instead of the inner wall of the branchial chamber. This change of position, the author finds, is entirely due to the manner in which the mantle cavity is developed. The species investigated by Dr. Osborn was *F. tulipa* Linn., var. *distans* Lam.

[1] H. Leslie Osborn. Studies from Biolog. Lab., Johns Hopkins University, III, No. 5, pp. 217–225, pl. XIII, 1885.

PSYCHOLOGY.

Intelligence of the Hen and Opossum.—Advices from home inform me that an early brood of chickens with the mother hen were taken into the cellar to protect them from the very cold weather which prevailed. Here they did well and appeared contented till a thaw and flood occurred. When the cellar was visited the next morning, several inches of water were found in it, flooding the quarters occupied by the brood. The hen was standing deep in the water with all of the chicks perched on her back. She was standing on the highest object to which she could step. She could have flown to higher objects, but this would have dislodged the youngsters and resulted in their being drowned.

This reminds me of an incident which I reported to the Naturalist many years ago, which may be briefly repeated. A boatman on the Illinois and Michigan canal observed an object on a fence-post, surrounded by water, which enabled him to work his boat up to it. There he found an opossum with several young ones in the pouch or pocket with which nature has provided this animal in which to carry her young. She was nearly famished and suffered herself to be taken on board without the least opposition and ate ravenously of the food given her. They were taken to Chicago and presented to my brother, in whose possession I saw them after the young ones had attained the size of small rats. They made rather pretty pets.

In both of these instances there seems to have been more of reason than of instinct, if by the latter we mean that inherited faculty which long-repeated emergencies has taught a long ancestral line a mode of avoiding or escaping danger.—*J. D. Caton.*

The Swallow as a Surgeon.—Dr. Walter F. Morgan, of Leavenworth, Kan., sends to the *Medical Record* this curious account of what may be called aviarian surgery, related to him in 1876 by the late Joseph O'Brien, Esq., of Cleveland, O.: "On going into his barn Mr. O'Brien discovered a swallow's nest, and being a natural observer and lover of animals, he climbed to the nest and found in it two young swallows, one being smaller and less vigorous than the other and having a slighter covering of feathers. Upon taking the young bird in his hand, he was astonished to find one of its legs very thoroughly bandaged with *horse-hairs.* Having carefully removed the hairs one by one, he was still more astonished to find that the nestling's leg was broken. Mr. O'Brien carefully replaced the bird in its nest and resolved to await further developments. Upon visiting the 'patient' the next day the leg was again found bandaged as before. The bird-surgeon was not again interfered with, and the case being kept under observation, in about two weeks it was found that the hairs were being cautiously removed, only a few each day; and finally

when all were taken off the callus was distinctly felt, and the union of bone evidently perfect, as the bird was able to fly off with its mates. Such instances may seem incredible to those not yet prepared to fully accept the axiom of the scientists, viz., 'That the intelligence of animals differs from that of man only in degree and not in kind.'"

ANTHROPOLOGY.[1]

Corea.—The United States National Museum has just received from Ensign J. B. Bernadou, U.S.N., a large and intelligently selected collection of ethnological objects from Corea. Among them are several illustrated books full of water-color sketches of Corean life. Almost the same day, Messrs. Ticknor & Co. sent us Mr. Percival Lowell's work entitled, "Chosŏn, the land of the Morning Calm, a sketch of Corea." We rarely have the opportunity of testing a book of travels, in an out-of-the-way region, by the touchstône of things. It has been for that reason a source of great pleasure to us to read Mr. Lowell's book, in the light of Ensign Bernadou's specimens. Perhaps the air of the philosopher, which the author here and there assumes, may to some readers appear the more attractive part. But to us, we must admit, the chief charm lies in the assurance, growing on us from page to page, that the writer is telling the truth. The journey to Söul from Chemulpo in a sedan-chair, and the khan heated with brush, are verities. We have seen pictures of these things painted by Coreans themselves, and they look like Mr. Lowell's descriptions. The walls, gateways, detached houses, endless series of courtyards, tile roofs, grinning monsters on the house tops, are well-drawn word pictures of things that have existence. Then the baggy clothing, pantaloons that measure just seventy-two inches in the waistband, great flowing surplices, shoes of straw, hats in endless variety, the sack-cloth of the mourner, these are portrayed so faithfully that we have only to transfer Mr. Lowell's language to the label. The three chapters, *impersonality*, *patriarchy* and the *position of woman*, are well and clearly worded expressions of convictions after a brief stay and superficial examination. Americans who have spent many years in the far east have lost some predilections on these subjects after a wider experience.

The palaces of Corea are essentially Chinese. First the great courtyard where horsemen dismount, bulls of burden halt, and sedan-chairs discharge their living cargoes. Then the arched gateways and paragons of roofs, covering the entrance to a first inner court, where bearers of gifts and invited guests arrange charms to captivate royalty. The graded ways and platforms leading to a verandahed throne-room, where soldiers and citizens vie in the gorgeousness of their profuse attire and especially

[1] Edited by Prof. Otis T. Mason, National Museum, Washington, D. C.

in the diversity of their hats. Above all, the affected grandeur of royalty amid decay and national poverty, these are all subjects which Mr. Lowell fully appreciates and describes with charming grace.

As to the population, Mr. Lowell says: "Money being more important to the Corean official oligarchy than men, the amount of taxable property in the kingdom, represented principally by rice fields, is much more accurately known than is the number of its inhabitants. No census of the population is ever taken, the number of the houses alone being counted. The estimate formed recently by a Japanese paper is probably the nearest yet made to the truth. This estimate gives Corea 12,000,000 inhabitants.

"As for Sŏul, the aggregate of population, including both the city proper—that is, the part within the wall—and the outlying suburbs, will probably not exceed in all 250,000 souls. The amount of ground covered is about ten square miles. But a city in the far east extends only in two dimensions, not, as with us, in three. Tokio, in Japan, with about 1,200,000 inhabitants, covers eighty square miles.

"The fabulously large estimated populations of Chinese cities—as for instance, Canton—will, I think, on trustworthy census be found to have been greatly exaggerated."

THE RELATION OF ANTHROPOLOGY TO THE SCIENCE OF MIND.—In the scheme of anthropology followed by the NATURALIST, the science of mind follows hard upon comparative physiology. In this journal, as it would be in an academy or scientific association, the rule has been to allow only those psychical inquiries to enter in which natural history methods and processes, well approved, have been engaged. It is with profound pleasure, therefore, that we draw attention to Dr. Alexander Bain's paper, read at the last meeting of the British Association, upon the scope of anthropology and its relation to the science of mind. Says this distinguished authority: "The mode of research, grounded on discriminative sensibility, and working up from that, according to the best known principles of our intellectual nature, may be contrasted with another mode which has always been in vogue, namely, finding out and noting any surprising feats that animals can perform, out of all proportion to what we should be led to expect of them. The spirit of such inquiries is rather to defy explanation than to promote it; they delight to nonplus and puzzle the scientific investigator, who is working his way upward by slow steps to the higher mysteries. Before accounting for the exceptional gifts of animals—the geniuses of a tribe—we should be able to prove the average and recurring capabilities.

"It is an error to suppose that mental qualities do not admit of measurement. No doubt the higher complex feelings of the mind are incapable of being stated with numerical precision, yet,

by a proper mode of approaching the subject, a very considerable degree of accuracy is attainable.

" As to the present position of the science of mind in the British Association, it is nowhere. Taken in snatches, it appears in several places; it would come in under zoölogy, which embraces all that relates to animals; under physiology, in connection with the nervous system and the senses; and it figures still more largely, although in an altogether subordinate and scarcely acknowledged fashion, in the section on anthropology. Indeed, to exclude it from this section would be impossible; man is nothing without his mind.

" Now, while zoölogy and physiology would keep the study of mind within narrow limits, there is no such narrowness in the present section. In the ample bosom of anthropology, any really valuable contribution to the science of mind should have a natural place.

" Psychology has now a very large area of neutral [non-controversial] information; it possesses materials gathered by the same methods of rigorous observation and induction that are followed in the other sciences. The researches of this section exemplify some of these. If these researches are persisted in, they will go still further into the heart of psychology as a science, and the true course will be to welcome all the new experiments for determining mental facts with precision, and to treat psychology as an acknowledged member of the section. To this subdivision would then be brought the researches into the brain and nerves that deal with mental functions; the experiments on the senses having reference to our sensations; the whole of the present mathematics of man, bodily and mental; the still more advanced inquiries relating to our intelligence; and the nature of emotion, as illustrated by expression, in the manner of Darwin's famous treatise. Indeed, if you were to admit such a paper as that contributed by Mr. Spencer to the Anthropological Institute, you would commit yourself to a much further raid on the ground of psychology than is implied in such an enumeration as the foregoing."—*J. Anthrop. Inst., xv, 380–388.*

Jewish Ability.—Mr. Joseph Jacobs, who has been communicating to the Anthropological Institute papers upon the Jewish race, reproduces in the February number of the journal of that society his paper, read at the Aberdeen meeting of the British Association. Applying to Jews Mr. Galton's methods with reference to hereditary genius in England, he aims to find how many eminent men, of certain rank, exist in each million of Englishmen, Scotchmen and Jews.

It follows that the 722,000th is equal in ability to the 739,000th Scotchman and the 756,000th Englishman, reckoning from the bottom. Or, in other words, if we took a hundred men at hazard

from each of the three races, the 72d Jew, reckoned from the least able, would equal in ability the 74th Scotchman or the 76th Englishman, and would be the superior to the 72d of either of the other two races. Thus we arrive at last at a real comparative estimate of Jewish ability, which we may state roughly in the following way: The average Jew has four per cent more ability than the average Englishman, and two per cent more than the average Scotchman.

The men of ability are arranged in grades, according to their eminence, over the space of a century. It is interesting to note even the names. In the first rank Mr. Jacobs places Benjamin Disraeli, Heinrich Heine, Ferdinand Lassalle and Felix Bartholdy-Mendelssohn. In the second class are Auerbach, Benfey, Börne, Cremieux, Gans, A. Geiger, Grætz, Halèvy, Sir W. Herschell, Jacobi, Jessel, Lasker, Maimon, Marx, Meyerbeer, Neander, Oppert, Palgrave, Rachel, Ricardo, Jules Simon, Steinthal and Lazarus, Sylvester, Steinschneider and Zunz.

The reasons assigned by Mr. Jacobs for Jewish ability in certain lines are doubtless correct, and furnish a confutation of the doctrine that only prosperity ministers to human progress.

THE MANGUE LANGUAGE.—Dr. Brinton read before the American Philosophical Society, in November last, a paper on the Mangue, an extinct dialect formerly spoken in Nicaragua. The chief source of this paper was the MS. of Don Juan Eligio de la Rocha. The Mangue is the mother-tongue, from which the Chiapanec of Chiapas branched off. The Mangues at one time occupied the whole coast, from the entrance of the Gulf of Nicoya to Fonseca bay. Some time in the fourteenth century a large colony of Aztecs descended the coast and seized the strip between Lake Nicaragua and the Pacific, thus splitting the Mangues in two and driving a large part of them from their homes.

"TABLEAU DES BACABS" is the name given by Leon de Rosny to a certain double plate of the Cortesian Codex. By that name he intended to indicate that the table or plate refers to the four Bacabs, or gods, which were supposed to bear up the four corners of the earth—the gods of the cardinal points.

On this plate are the four characters supposed to be the symbols of the cardinal points. As these probably occupy on this plate their proper relative positions, we have here, perhaps, the best existing data by which to determine the respective points to which the symbols are assigned.

Entering upon the study of the plate with this object in view, I soon formed the opinion that the plate is, in fact, a calendar table. The discovery that the rows of day symbols, lines and dots in the outer form but a single continuous line and cover one cycle of thirteen months, or 260 days, convinces him of the correctness of this opinion. Applying this discovery to the plate 44 of the

Fejervary Codex, and bearing in mind that it was Mexican, it was readily shown to be a calendar formed upon the same plan as the "Tableau des Bacabs." His next step was to determine, if possible, the object of the singular arrangement of the days in the middle circle of the Cortesian plate and in the corners of the Fejervary plate. This he has shown clearly to have been in accordance with both a Maya and Mexican custom of dividing the twenty days of the month into four groups by placing them in the order they come, one alternating in each group. Each of these groups have a special relation to one of the four years of both calendar systems. The first part of my paper is devoted to the explanation and discussion of these points; the remaining portion to the proper assignment of the cardinal point symbols. In the course of this discussion, I enter at some length into the question of the assignment of the years, colors and elements.

Since the publication of this paper, it has been ascertained that some of the conclusions reached by me have been arrived at independently by one or two of the European students, whose papers on these codices will shortly be published. I am now satisfied that I am able to explain and illustrate the use and significance of nearly all the numerals in the Dresden and other Maya codices. By means of this discovery, the reality of which is demonstrable, most of the obliterated day symbols and numeral characters can be restored and errors in the reproductions detected. This discovery shows that these calendar systems are much simpler than they have been supposed to be.—*Cyrus Thomas.*

ABORIGINAL BAKING PANS.—I wish to call the special attention of archæologist to a form of stone implement upon which additional light has been thrown. Lt. Ray, U.S A., has just sent to the National Museum a collection of objects illustrating the aboriginal industries of the Hupa Indians of California. Among these are five stone implements, called baking pans, used in cooking bread made of acorn meal. They may be very properly termed "individual" pans, each of them holding enough meal to bake a good-sized corn-cake, with brown crust all around. They are made either of lapisollaris, or of a soft schist not subject to fire-cracks. The dimensions are as follows, although the outline is a very irregular oval:

77,160.—Length, 3½ inches; width, 2¼ inches; height, ¾ inch.
77,161.—Length, 3¾ inches; width, 3½ inches; height, 1½ inches.
77,162.—Length, 5 inches; width, 3¾ inches; height, 1½ inches.
77,163.—Length, 4¾ inches; width, 3¾ inches; height 2½ inches.
77,164.—Length, 6¾ inches; width, 5½ inches; height, 1¾ inches.

With the exception of 77,163, of schist, they are from ¾ to 1 inch thick. Comparing these with our archæological collections, I find many specimens of soft material labeled paint-cups, which are much more likely to have been individual baking pans.

War-Clubs vs. Digging-Sticks.—Toward the end of April the secretary of the Smithsonian Institution received from Dr. Stephen Bowers, of San Buenaventura, California, editor of the *Pacific Science Monthly*, No. 4, Vol. 1, of that publication, containing an account of the discovery of Indian relics in a cave in the San Martin mountains, Los Angeles county, California. Among the relics were four heavy perforated stone (probably serpentine) disks, measuring from four to five and a half inches in diameter, and still retaining their handles of *toyon* or bearberry-wood, which is among the hardest in Southern California. The handles are from thirteen to seventeen inches in length, and are cut off bluntly. To judge from an accompanying photograph, the stones are in every way analogous to a certain class among the many perforated stones collected by Mr. Paul Schumacher and others in the same neighborhood, and now in the archæological collection of the National Museum.

Dr. Rau expressed ten years ago (in "Archæological Collection of the U. S. National Museum," p. 31), the opinion that the more bulky of the Californian disk or cone-shaped stones served as club-heads, and he was strengthened in his view by the fact that the extensive National Museum collections from the above-named region contain no other heavy implements which could have been used for striking; but he could not then foresee that his theory would be so unexpectedly verified by the finding of such stones with their handles still inserted. Mr. Schumacher considered the stones as weights for digging-sticks, relying on the statement of a half-breed *vaquero*.

The Aztec Language is still the favorite language among linguistic students as well as among the scholarly authors of books on American ethnology. The harmonious, vocalic structure of its words as well as the copiousness of its literature may account for that, and we gratefully acknowledge every new effort to popularize the study of Aztec, whenever such efforts rest on a scientific basis. The director of the Mexican Statistical Bureau, Mr. Ant. Peñafiel, has made a new advance in that direction by republishing the "Arte Mexicana" of the Jesuit priest of Puebla, Antonio del Rincon (died 1601), who after a prolonged theoretic study of his own dialect, that of Tezcuco, published the above Aztec grammar in 1595. Antonio del Rincon was a descendant of the "kings" of Tezcuco, near Mexico, and as such had peculiar facilities of becoming acquainted with all the dialects of Anahuac, if not of the whole Nahuatl family. In the vocabulary appended, he differs in many points from Molina, and whether he then gives his native Tezcucan dialect forms or varying forms of the "literary" Aztec, is not always possible to find out. As an early source for dialectic study the "Arte Mexicana" will prove to be of peculiar value.—*A. S. Gatschet.*

MICROSCOPY.[1]

STRUCTURE OF THE HUMAN SKIN.—The following note refers to a method of isolating the epidermis of human and other embryos from the underlying dermis, and to the presence of a layer of cells, not previously described, which may be observed in the epidermis when so prepared, and which corresponds, I think, to the epitrichium of birds. The method is also convenient for the study of the development of hairs.

It is well known to physicians that if the fœtus dies and is retained, it is preserved for a considerable period without disintegration of the tissues in the amniotic fluid. In specimens thus preserved it is often found that the epidermis is loosened so much that strips can be removed without tearing off the underlying tissues. Now as the amniotic fluid is little more than a salt solution, the facts just stated naturally suggest that a salt solution preserved from septic changes is sufficient to loosen the epidermis of the embryo. My experiments have satisfied me that a sojourn of several days in a 0.6 per cent solution of common salt, with 0.1 per cent thymol added to prevent putrefaction, is a simple and satisfactory way of liberating the embryonic epidermis from its connections, so that bits can be easily removed for histological examination, for which they are apparently still adapted; even the minute structure of the nucleus will persist through this treatment, though imperfectly.

A piece of epidermis of a human embryo, of about six months, taken from the scalp by this method and stained with hæmatoxyline, is shown in the accompanying figure;[2] each dot represents a nucleus. We distinguish two kinds of nuclei, those which are darker stained and those which are lighter. Some of the nuclei in the figure appear darker from another cause to be stated directly, but with the exception of these, all the dark nuclei belong to cells which participate in the formation of the hairs. At first the dark nuclei make a little cluster, as at *1* and *2;* the clusters grow in size; one a litttle larger is seen just to the left of that numbered *2*, one a good deal larger is shown at *3*. Sections show that such clusters are on the under side of the epidermis and form slight protuberances or rudimentary papillæ; the papillæ lengthen out and acquire rounded ends, *4;* they grow rapidly down into the cutis, and by the contraction of their upper part become club-shaped, *5* and *6*. The next step is the formation of the dermal papillæ of the hair, *7;* a little notch arises at the thick end of the epidermal ingrowth, and the tissue filling this notch is the so-called dermal papilla. The figure presents also a well-developed hair; here the axial portion of the papilla has formed the hair, *h*, while the cortical portion has formed the follicle, *f;* the end of the

[1] Edited by Dr. C. O. WHITMAN, Mus. Comparative Zoölogy, Cambridge, Mass.

[2] The illustrations are borrowed from a forthcoming work on human embryology.

hair is thickened, *h'*, as the so-called hair bulb; the sebaceous gland, *Gl*, has begun to grow out from the follicular walls. In the upper part of the follicle the hair lies quite free, hence in several places where the hairs have been forcibly torn off the upper part of the follicle, *F*, still remains, while the lower part attached

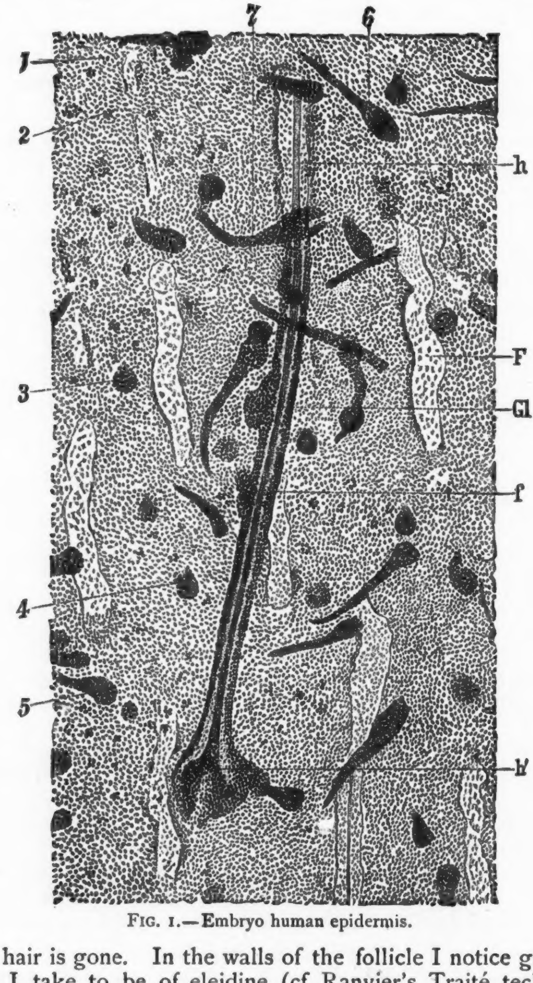


Fig. 1.—Embryo human epidermis.

to the hair is gone. In the walls of the follicle I notice granules which I take to be of eleidine (cf. Ranvier's Traité technique, p. 890).

The above description contains nothing new, and is intended

to serve merely as an explanation of the preparation regarded as an object to demonstrate the development of hairs. The preparation also reveals the existence of an important undescribed layer in the skin, namely, the epitrichium.

With a low power one observes in the preparation we have been considering, and in others similar to it, that there are scattered about everywhere little groups of nuclei, three to five, as *r* in Fig. 1, which appear darker than the rest; only a very few of these are represented in the drawing; examination with a higher power shows that this effect is produced by large stained bodies lying on the outer surface of the skin.

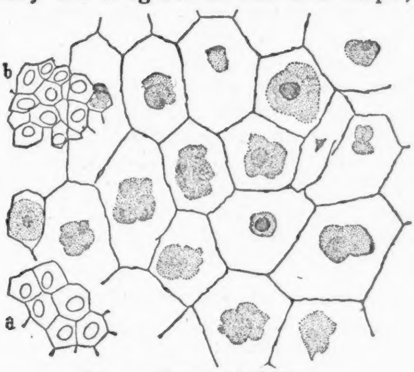


FIG. 2.—Human epitrichium.

The characters of the bodies in question are indicated by the accompanying figure. They are irregular in size and shape; quite granular; in preparations stained in picric-acid carmine each body is rèadily seen to lie in a separate area with very distinct polygonal outlines, but the area is only partly filled by the body; occasionally there is a distinct round body of smaller size and more darkly stained than the main body we are now describing. I consider the outlines to be cellular, the granular bodies to be the shrunken mass of protoplasm of the cells, and the inner round body to be the nucleus. In fact, the supposed nuclei appear very clearly in almost every one of the cells after a specimen has been stained by alum hæmatoxyline. The cells are very much larger than those of the horny layer proper, two layers of which are drawn in, in the figure, to scale for comparison. The layer of cells is continuous over the whole surface, even over the hair follicles and the hairs, and is absolutely distinct from the horny layer. It can hardly be questioned that it is homologous with the so-called epitrichium of birds and reptiles. For a full account of the epitrichium of those animals, I refer to the valuable memoir by E. G. Gardiner in the Archiv. für mikroskopische Anatomie, Vol. XXIV, p. 289. Welcker long ago (1864) showed that an epitrichium, or a special layer outside of the horny layer, exists in various mammals, but Kölliker has expressly denied the occurrence of a true epitrichium in man, and after saying in his larger Entwickelungsgeschichte (2d ed., p. 776) that the outer parts of the horny layer may be thrown off, adds, " it has not been demonstrated, that over all and

in the first instance only the external layer is sloughed off, and that between this and the next following horny layers there is a definite contrast." As we have seen, the distinguished Würzburg embryologist has expressed doubts not justified by the facts, there being an external layer which is extremely different from the horny layer, and is apparently a true epitrichium.

The human epitrichium, so far as I have observed, is developed quite late, about the fourth or fifth month, though to be sure an enlargement of the outermost epidermal cells may be observed earlier than this.

I deem it probable that the presence of the epitrichium as an intact membrane results in the retention of the secretions of the fœtal sebaceous glands, and is therefore the immediate cause of that hitherto unexplained phenomenon, the formation of the so-called *vernix caseosa* of physicians.

It is not rare in science that something, easily seen, remains long overlooked, and each time we are touched by surprise when observation is thus corrected. Certainly the human skin is not a structure which the microscopist would have searched in order to discover a new layer of cells, which are easily demonstrated and very conspicuous. I may confess that I looked at the preparations, which show the epitrichium plainly, a great many times without observing at all what I now see at the first glance.—*Charles Sedgwick Minot.*

KARYOKINESIS.—In the study of karyokinesis in the arthropods, Professor J. B. Carnoy[1] obtained the best results with the two following mixtures:

(1)[2]	Chromic acid (2 p. c. or more)	45 parts.
	Osmic acid (2 p. c.)	16 "
	Glacial acetic acid	3 "
(2)	Corrosive sublimate	
	Glacial acetic acid (1 p. c.).	

The object (testes) is left from six to ten minutes in one of these mixtures; then washed in distilled waters and further hardened in alcohol.

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SCIENTIFIC NEWS.

—Edward Tuckerman, professor of botany in Amherst College, died March 15, aged sixty-nine years. He was a graduate of Union College (1837), of Harvard College (1846), of the Harvard Law School (1839); studied history, philosophy and botany several years in Germany, and in 1858 was appointed to the chair of botany at Amherst College, which he held to the day of

[1] La Cytodiérèse chez les Arthropodes, p. 211. (Extrait de la Revue "La Cellule," I, 2o fas., Louvain, 1885.)

[2] Modified form of Flemming's mixture.

his death. Distinguished as a lichenologist, Tuckerman was one of our most philosophical botanists, and a ripe scholar, with literary skill of a high order, belonging to a family well known for its literary and musical tastes. Professor Tuckerman was a pioneer in the study of the White Mountain flora. His name as an explorer will be ever remembered in the ravine of Mt. Washington, which bears his name. Among his principal works are the following: "An enumeration of North American Lichenes," 1845; "A synopsis of the Lichenes of New England, the other Northern States and British America," 1848; "Genera Lichenum: an arrangement of the North American Lichens," 1872; "A synopsis of the North American Lichens," part 1, 1882. He also contributed the chapter on lichenes to the botany of Wilkes' U. S. Exploring Expedition, and was the author of a number of other papers and works.

—The annual report of the trustees of the American Museum of Natural History in Central Park, New York, for 1885-86, shows gratifying progress in the scientific development of that institution. The expenditures for maintenance were $30,508.80, while $6,654.16 were spent for improvements and additions to the collections; $50,937.50, a gift of Mr. W. H. Vanderbilt, being carried to the endowment fund. The purchases include the Bailey collection of birds' nest and eggs, toward the purchase of which Mrs. Robert L. Stewart contributed $1500.

—The celebration of the sixty-ninth year of the New York Academy of Sciences took place on the evening of May 10th, at Columbia College. Secretary H. L. Fairchild read an interesting *résumé* of the society's history. Dr. Asa Gray read his first paper before this society. Its first president was the Hon. Samuel L. Mitchell, who held the office seven years. He was succeeded by Dr. John Torrey, Major Joseph Delafield, Professor Charles A. Joy and Dr. John S. Newberry. The history of the society will form the subject of a forthcoming volume.

—From the report of the Zoölogical Society of Philadelphia it appears that, as the result of special effort, $22,000 were raised for the present and future support of the garden. Still a large endowment fund is needed to render the garden permanent. The most remarkable addition was a pair of hairy-nosed wombats from Australia. A notable addition is three hybrids between a female *Canis latrans* and a male dog, said to be a Scotch colley.

—An interesting feature of recent numbers of the Journal of the Royal Microscopical Society has been the publication of portraits from photographs of all the presidents of the society. The April number furnishes a full-page likeness of the present president, Rev. W. H. Dallinger.

—Mr. Alfred R. Wallace, the distinguished English naturalist, is to give a course of eight lectures at the Lowell Institute, Boston, Mass., beginning in November next.

—Mr. C. W. Peach, so well known as a zealous field naturalist and collector of fossils, whose name appeared so often in Gosse's sea-side books, died in March.

—Dr. T. Spencer Cobbold, well known for his work on parasitic worms, died in London in March, aged fifty-seven.

—The eminent botanist of Liegé, Professor C. J. E. Morren, died late in February at the age of fifty-three years.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

National Academy of Sciences.—In addition to the list of papers read at the Washington meeting the following were presented April 21st and 22d:

On color contrast. By Ogden N. Rood.

Classification of the Cambrian system of North America (by invitation). By Chas. D. Walcott.

Crystallization of platinum by means of the electric discharge in vacuo. By A. W. Wright.

The Stomatopoda of the "Challenger" collection. By W. K. Brooks.

Budding in the Tunicata. By W. K. Brooks.

Effect of magnetization on the electrical resistance of metals. By A. W. Wright.

On a proposed expedition into the interior of Greenland during the present summer with Disco as a base (by invitation). By R. E. Peary, U. S. N.

At an evening meeting of the academy the Henry Draper medal was for the first time awarded to Professor S. P. Langley for his researches on solar physics. The Watson medal, with an honorarium of one hundred dollars, was given to Dr. B. A. Gould as a recognition of his services to astronomy in founding and conducting the Cordova observatory. At the same meeting a biographical notice of the late Professor Arnold Guyot, prepared by Professor J. D. Dana, was presented, and a similar notice of the late Professor John W. Draper was read by Professor Barker.

Biological Society of Washington, March 6.—Communications: Dr. George Vasey, New and recent species of North American grasses; Mr. Charles Hallock, Hyper-instinct of animals; Dr. W. S. Barnard, Exhibition of a fungus, with remarks; Dr. H. G. Beyer, U. S. N., Remarks on antipyretics.

March 20.—Communications: Dr. D. E. Salmon and Dr. Th. Smith, Notes on some biological analyses of Potomac drinking-water; Dr. H. G. Beyer, U. S. N., Remarks on antipyretics; Dr. W. S. Barnard, Exhibition of a fungus, with remarks; Mr. F. H.

Knowlton, Additions to and changes in the Flora Columbiana for 1885.

April 3.—Communications: Dr. Frank Baker and Mr. J. L. Wortman, Recent investigations into the mechanism of the elbow-joint; Mr. J. B. Smith, Some peculiar secondary sexual characters in the Deltoids, and their supposed function; Dr. C. Hart Merriam, Contributions to North American mammalogy—III. Description of a new sub-species of a gray squirrel; Dr. R. W. Shufeldt, U. S. A., Some early and as yet unpublished drawings of Audubon.

April 17.—Communications: Dr. Theo. Gill, The characteristics and families of iniomous fishes; Mr. F. A. Lucas, Notes on the vertebræ of Amphiuma, Siren and Menopoma; Mr. Frederick True, 1. Exhibition of a wood hare with abnormal growth of fur; 2. Some distinctive cranial characters of the Canadian lynx; Mr. John B. Smith, Ants' nests and their inhabitants.

May 1.—Communications: Dr. R. E. C. Stearns, Instances of the effect of musical sounds on animals; Dr. John A. Ryder, The evolution of the mammalian placenta; Dr. T. H. Bean, The trout of North America, with exhibition of specimens; Mr. W. H. Dall, 1. On the attachment of Lingula, with exhibition of specimens; 2. On the divisions of the genus Pecten.

New York Academy of Sciences, March 15, 1886.—Recent progress in chemistry, by Dr. H. Carrington Bolton, of Trinity College, Hartford, Conn.

March 22.—Significance of flora to the Iroquois (with grammatical notes), by Mrs. Erminnie A. Smith.

March 29.—Theories concerning the protective influence of mitigated virus, by Mr. Lucius Pitkin.

April 5.—Geological notes in Western Virginia, North Carolina and Eastern Tennessee (illustrated with specimens), by Dr. N. L. Britton.

April 19.—Mineralogical notes (*a*, On the hardness of a Brazilian diamond; *b*, A fifth mass of meteoric iron from Augusta county, Va.; *c*, Asteriation in garnet), by Mr. Geo. F. Kunz; Minerals of Staten Island, by Mr. B. B. Chamberlin.

April 26.—On the variation of decomposition in iron pyrites, its cause, and its relation to density, by Dr. Alexis A. Julien.

May 3.—Review of the fossil fishes of North America, with notice of some new species, illustrated with specimens and lantern views, by Dr. J. S. Newberry.

Boston Society of Natural History, March 17, 1886.—Dr. C. C. Abbot described the habits of the white-footed mouse; Professor Wm. Trelease read a paper on the North American species of Thalictrum (meadow rue); Professor W. T. Sedgwick

exhibited some new and simple forms of apparatus in use in the biological laboratory of the Massachusetts Institute of Technology.

April 7.—Dr. R. R. Andrews read a paper on the development of the teeth (illustrated by the stereopticon); Dr. S. Kneeland showed some metallic tubes from a girdle found on an Indian skeleton at Fall river—the so-called "Skeleton in Armor;" and Mr. S. H. Scudder spoke of the mode of life of an ancient beetle.

April 21.—Mr. Percival Lowell read a paper on the Corean language; and Professor A. Hyatt showed and explained Hatscheck's models of the development of a vertebrate (Amphioxus).

May 5.—The annual meeting was held on this date. Business: Annual reports of the curator, secretary, and treasurer, on the condition and work of the society; report of the committee on the Walker prize for 1886; election of officers for 1886–7. Communication: Dr. G. L. Goodale read a paper upon plasmolysis.

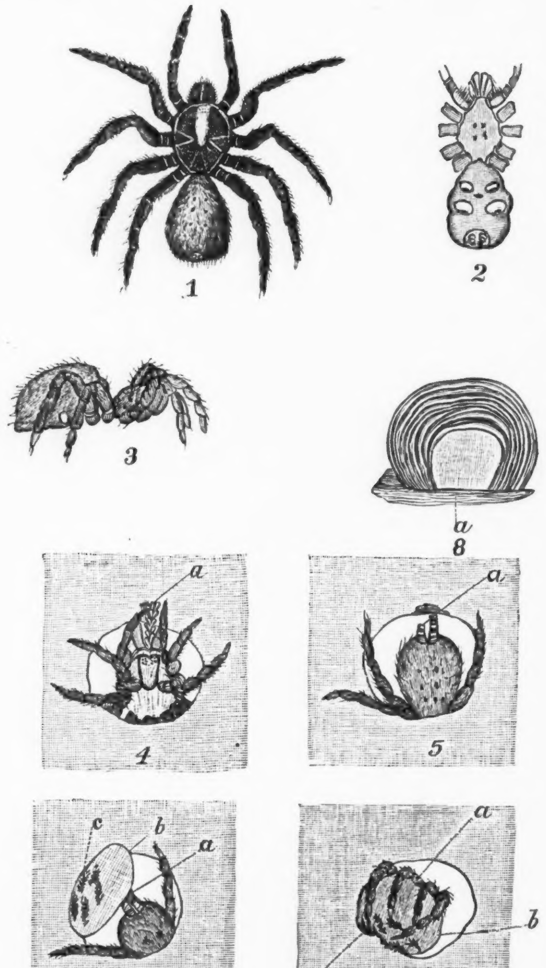
Appalachian Mountain Club, March 10, 1886.—Mr. J. Rayner Edmands read a paper entitled "A day on Flume mountain and a night in the wilderness;" Mr. S. H. Scudder made some remarks on the progress of the State topographical survey; Mr. Rosewell B. Lawrence exhibited a new map of Middlesex Fells, intended to show wood-roads and foot-paths. The following subject was presented for discussion: What should be done by or for persons detained (possibly lost or injured) among woods and mountains?

March 23.—Mr. S. H. Scudder occupied the evening with an account of his three months' adventures by stage, canoe and ox-cart with an eclipse party in the Winnepeg and Saskatchewan country a quarter of a century ago.

April 14.—A paper by Professor A. S. Packard, entitled "Over the Mexican plateau on a diligence," was read by Mr. F. W. Freeborn; Professor E. C. Pickering presented for discussion plans for a summer school in geodesy and topography.

April 20.—A semi-social meeting was held from 7.30 to 10.30. During the evening Rev. John Worcester showed fifty lantern views of scenery on the Great Range.

PLATE XXIII.



G.F. Atkinson del.

A new Trap-door Spider.